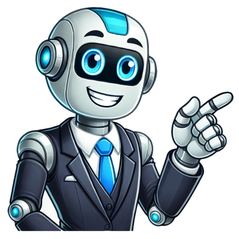
Continue



Ground resistance testing, also known as earth resistance testing, is the process of measuring the resistance of a grounding system to the Earth. The purpose of this test is to ensure that the grounding system is functioning effectively and safely.Accurate ground resistance measurements help identify and address any potential issues, such as inadequate grounding or high soil resistivity, which can affect the overall performance of electrical systems.The procedures for earth resistance testing are referenced in IEEE Standard 81. Four of the most common methods of ground resistance testing used by test technicians in the field are discussed below:2-point (dead earth) methodIn areas where driving ground rods may be impractical, the two-point method can be used.With this method, the resistance of two electrodes in a series is measured by connecting the P1 and C1 terminals to the ground electrode under test; P2 and C2 connect to a separate all-metallic grounding point (like a water pipe or building steel).The two-point method is most effective for quickly testing the connections and conductors between connection points. Photo: TestGuy.The dead earth method is the simplest way to obtain a ground resistance reading but is not as accurate as the three-point method and should only be used as a last resort. It is most effective for quickly testing the connections and conductors between connection points.Note: The earth electrode under test must be far enough away from the secondary grounding point to be outside its sphere of influence to obtain an accurate reading.3-point (Fall-of-potential) methodThe three-point method is the most thorough and reliable test method; used for measuring resistance to earth of an installed grounding electrode.The standard used as a reference for fall-of-potential testing is IEEE Standard 81: Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System.With a four terminal tester, P1 and C1 terminals on the instrument are jumped and connected to the earth electrode under test while the C2 reference rod is driven into the earth straight out as far from the electrode under test as possible. Potential reference P2 is then driven into the earth, at a set number of points, roughly on a straight line between C1 and C2. Resistance readings are logged for each P2 point.Fall-of-potential test method. Photo Credit: MeggerMeasurements are plotted on a curve of resistance vs. distance. Correct earth resistance is read from the curve for the distance that is roughly 62% of the total distance between C1 and C2. There are three basic types of the fall-of-potential method:Full fall-of-potential: A number of tests are made a different spaces of P and a full resistance curve is plotted.Simplified fall-of-potential: Three measurements are made at defined distances of P and mathematical calculations are used to determine the resistance.61.8 Rule: A single measurement is made with P at a distance 61.8% (62%) of the distance between C1 and C2.Note: Fall-of-potential testing, and its modifications, is the only ground testing method that conforms to IEEE 81.4-point methodThis method is the most commonly used for measuring soil resistivity, which is important for designing electrical grounding systems. In this method, four small-sized electrodes are driven into the earth at the same depth and equal distance apart - in a straight line - and a measurement is taken.The Wenner four-pin method, as shown in figure above, is the most commonly used technique for soil resistivity measurements. Photo Credit: WikimediaThe amount of moisture and salt content of soil radically affects its resistivity. Soil resistivity measurements will also be affected by existing nearby grounded electrodes. Buried conductive objects in contact with the soil can invalidate readings if they are close enough to alter the test current flow pattern. This is particularly true for large or long objects.Related: What is Soil Resistivity and Why Does it Matter?Clamp-on methodThe clamp on method is unique in that it offers the ability to measure resistance without disconnecting the ground system. It is quick, easy, and also includes the bond to ground and overall grounding connection resistances in its measurement.Measurements are made by clamping the tester around the grounding electrode under test, similar to how you would measure current with a multi-meter current clamp.The clamp on method is unique in that it offers the ability to measure resistance without disconnecting the ground system. Photo Credit: AEMCThe tester applies a known voltage without a direct electrical connection via a transmit coil and measures the current via a receive coil. The test is carried out at a high frequency to enable the transformers to be as small and practical as possible.For the clamp-on method to be effective, there must be a complete grounding circuit in place. The tester measures the complete resistance path (loop) that the signal is taking. All elements of the loop are measured in series. It is important for the operator to understand the limitations of the test method so that he/she does not misuse the instrument and get erroneous or misleading readings.Some limitations of the clamp-on method include:effective only in situations with multiple grounds in parallel.cannot be used on isolated grounds, not applicable for installation checks or commissioning new sites.cannot be used if an alternate lower resistance return exists not involving the soil, such as with cellular towers or substations.results must be accepted on faith. IEEE 81 highlights the use of a Computer-Based Technology for ground impedance measurement. This method, though more expensive than traditional ground testing, offers greater accuracy and flexibility.Computer-based technology builds on basic ground testing techniques, where an operator generates a test signal and positions sensing probes. The difference being that advanced software processes numerous data points, providing highly accurate and reliable results beyond manual analysis capabilities.This precision is particularly valuable for large and complex grounding systems, especially when third-party validation, extensive documentation, and audits are necessary.References What is ground resistance testing? It is a test done to measure the resistance between a grounding electrode and earth. Specialized earth testers, like the Fluke 1630-2 FC Earth Ground Clamp and the Fluke 1625-2 GEO Earth Ground Tester, are the troubleshooting tools built to make earth ground tests a lot easier. How do you perform ground testing? Depending on the situation youre in and what kind of ground setup youre looking at, there are four different methods of testing earth ground resistance available.1. Stakeless earth ground testingStakeless testing uses only two clamps, one as a signal generator and one as a receiver, or one clamp like the 1630-2 FC, to make the measurements . It entirely eliminates the need for temporary ground stakes and is very useful when stakes cant be driven into the ground. It also eliminates the dangerous and time-consuming process of disconnecting parallel grounds and finding a safe place to drive the stakes.The stakeless method is the preferred method when parallel grounds are present and temporary ground stakes would be difficult to be driven in the ground. The stakeless method can be done with just one tool: the 1630-2 Earth Ground Clamp. Just clamp in on and measure away. You can use it both as a voltage generator and an amp clamp in one jaw. Plus, you can measure for low leakage current in a building at the same time.You can also use this method with two clamps attached to a 1625-2. The first clamp is placed around the ground conductor and generates a voltage. The second clamp measures the current flowing due to the voltage generated from the first clamp.2. Selective earth ground testingThe selective testing method uses one clamp and two stakes. It allows you to measure the ground resistance at specific parts of an installation, isolating the system to check or reference whats in place.The selective testing method uses a current clamp while the electrode of interest is still under test. The clamp meter, like a Fluke 1625-2, is used to isolate the test current injected into the electrode under test.Two earth stakes are placed in the soil in a direct line away from the electrode of interest, usually spacing of 20 meters is sufficient. The clamp meter is connected to the electrode and the Earth Ground Clamp meter is placed around the electrode to eliminate the effects of parallel resistances in a ground system. This allows only the earth electrode of interest to be measured.3. Soil resistivity earth ground testThe soil resistivitymeasurement method uses four stakes and is typically used before installing an earthing arrangement. The soil composition, moisture content, and temperature all impact the resistance measurements youll see, so this testing is necessary to determine the design when installing a new grounding system. Taking these steps to check out the site before figuring out the layout or building begins. Ideally, youd want to find a location with the lowest possible resistance to work with. This is also used to reassess an environment after, for example, a drought.To test soil resistivity, connect the Fluke 1625-2 to four stakes in the ground. The earth ground tester will generate a known current through the outer two stakes and the inner two will measure any drop in voltage potential. The tester then automatically calculates soil resistance using Ohms law.4. Fall of Potential earth ground testFall of potential measurement uses two stakes and the electrode under test to prove the correct installation of a system, check the grounding system thats already in place before building, or this type of test can be used as part of a continued maintenance program.To run a test with this method, you first have to make sure the ground electrode of interest is disconnected from the site. Once thats done you place two earth stakes in the soil in a direct lineline them up away from the earth electrode of interest, usually 20 meters apart is sufficient.The 1625-2 will generate a known current between the outer stake and the ground electrode while the inner stake measures for any drop in voltage potential.Ground testing requirementsIdeally, the ground resistance of a system is zero ohms, but in reality, this isnt always achievable. Both the National Fire Protection Association (NFPA) and IEEE recommend a ground resistance value of 5.0 ohms or less. But, when you dive further into the National Electric Code (NEC), section 250.56 says that you want to make sure the system to ground is 25.0 ohms or less. In facilities with sensitive equipment, it should be 5.0 ohms or less. It all boils down to a goal of achieving the lowest ground resistance possible that makes sense economically and physically.The NEC also requires a minimum electrode length of 2.5 meters (8 feet) to be in contact with the soil in order to have a ground resistance system. But there are also four variables that affect ground resistance in a ground system:Length / Depth of the ground electrode: double the length, reduce ground resistance by up to 40%Diameter of the ground electrode: double the diameter, lower ground resistance by only 10%Number of ground electrodes: for increased effectiveness, space additional electrodes at least equal to the depth of the ground electrodesGround system design: single ground rod to ground plateEach electrode must also be the proper spacing between them to reduce or eliminate their spheres of influence. This will vary depending on the size and shape of the conducting material. The proper distance apart ensures the test stakes are not influenced by one another, or a ground system under test.What is ground resistance testing? It is a test done to measure the resistance between a grounding electrode and earth. Specialized earth testers, like the Fluke 1630-2 FC Earth Ground Clamp and the Fluke 1625-2 GEO Earth Ground Tester, are the troubleshooting tools built to make earth ground tests a lot easier. How do you perform ground testing? Depending on the situation youre in and what kind of ground setup youre looking at, there are four different methods of testing earth ground resistance available.1. Stakeless earth ground testingStakeless testing uses only two clamps, one as a signal generator and one as a receiver, or one clamp like the 1630-2 FC, to make the measurements . It entirely eliminates the need for temporary ground stakes and is very useful when stakes cant be driven into the ground. It also eliminates the dangerous and time-consuming process of disconnecting parallel grounds and finding a safe place to drive the stakes.The stakeless method is the preferred method when parallel grounds are present and temporary ground stakes would be difficult to be driven in the ground. The stakeless method can be done with just one tool: the 1630-2 Earth Ground Clamp. Just clamp in on and measure away. You can use it both as a voltage generator and an amp clamp in one jaw. Plus, you can measure for low leakage current in a building at the same time.You can also use this method with two clamps attached to a 1625-2. The first clamp is placed around the ground conductor and generates a voltage. The second clamp measures the current flowing due to the voltage generated from the first clamp.2. Selective earth ground testingThe selective testing method uses one clamp and two stakes. It allows you to measure the ground resistance at specific parts of an installation, isolating the system to check or reference whats in place.The selective testing method uses a current clamp while the electrode of interest is still under test. The clamp meter, like a Fluke 1625-2, is used to isolate the test current injected into the electrode under test.Two earth stakes are placed in the soil in a direct line away from the electrode of interest, usually spacing of 20 meters is sufficient. The clamp meter is connected to the electrode and the Earth Ground Clamp meter is placed around the electrode to eliminate the effects of parallel resistances in a ground system. This allows only the earth electrode of interest to be measured.3. Soil resistivity earth ground testThe soil resistivitymeasurement method uses four stakes and is typically used before installing an earthing arrangement. The soil composition, moisture content, and temperature all impact the resistance measurements youll see, so this testing is necessary to determine the design when installing a new grounding system. Taking these steps to check out the site before figuring out the layout or building begins. Ideally, youd want to find a location with the lowest possible resistance to work with. This is also used to reassess an environment after, for example, a drought.To test soil resistivity, connect the Fluke 1625-2 to four stakes in the ground. The earth ground tester will generate a known current through the outer two stakes and the inner two will measure any drop in voltage potential. The tester then automatically calculates soil resistance using Ohms law.4. Fall of Potential earth ground testFall of potential measurement uses two stakes and the electrode under test to prove the correct installation of a system, check the grounding system thats already in place before building, or this type of test can be used as part of a continued maintenance program.To run a test with this method, you first have to make sure the ground electrode of interest is disconnected from the site. Once thats done you place two earth stakes in the soil in a direct lineline them up away from the earth electrode of interest, usually 20 meters apart is sufficient.The 1625-2 will generate a known current between the outer stake and the ground electrode while the inner stake measures for any drop in voltage potential.Ground testing requirementsIdeally, the ground resistance of a system is zero ohms, but in reality, this isnt always achievable. Both the National Fire Protection Association (NFPA) and IEEE recommend a ground resistance value of 5.0 ohms or less. But, when you dive further into the National Electric Code (NEC), section 250.56 says that you want to make sure the system to ground is 25.0 ohms or less. In facilities with sensitive equipment, it should be 5.0 ohms or less. It all boils down to a goal of achieving the lowest ground resistance possible that makes sense economically and physically.The NEC also requires a minimum electrode length of 2.5 meters (8 feet) to be in contact with the soil in order to have a ground resistance system. But there are also four variables that affect ground resistance in a ground system:Length / Depth of the ground electrode: double the length, reduce ground resistance by up to 40%Diameter of the ground electrode: double the diameter, lower ground resistance by only 10%Number of ground electrodes: for increased effectiveness, space additional electrodes at least equal to the depth of the ground electrodesGround system design: single ground rod to ground plateEach electrode must also be the proper spacing between them to reduce or eliminate their spheres of influence. This will vary depending on the size and shape of the conducting material. The proper distance apart ensures the test stakes are not influenced by one another, or a ground system under test.What is ground resistance testing? It is a test done to measure the resistance between a grounding electrode and earth. Specialized earth testers, like the Fluke 1630-2 FC Earth Ground Clamp and the Fluke 1625-2 GEO Earth Ground Tester, are the troubleshooting tools built to make earth ground tests a lot easier. How do you perform ground testing? Depending on the situation youre in and what kind of ground setup youre looking at, there are four different methods of testing earth ground resistance available.1. Stakeless earth ground testingStakeless testing uses only two clamps, one as a signal generator and one as a receiver, or one clamp like the 1630-2 FC, to make the measurements . It entirely eliminates the need for temporary ground stakes and is very useful when stakes cant be driven into the ground. It also eliminates the dangerous and time-consuming process of disconnecting parallel grounds and finding a safe place to drive the stakes.The stakeless method is the preferred method when parallel grounds are present and temporary ground stakes would be difficult to be driven in the ground. The stakeless method can be done with just one tool: the 1630-2 Earth Ground Clamp. Just clamp in on and measure away. You can use it both as a voltage generator and an amp clamp in one jaw. Plus, you can measure for low leakage current in a building at the same time.You can also use this method with two clamps attached to a 1625-2. The first clamp is placed around the ground conductor and generates a voltage. The second clamp measures the current flowing due to the voltage generated from the first clamp.2. Selective earth ground testingThe selective testing method uses one clamp and two stakes. It allows you to measure the ground resistance at specific parts of an installation, isolating the system to check or reference whats in place.The selective testing method uses a current clamp while the electrode of interest is still under test. The clamp meter, like a Fluke 1625-2, is used to isolate the test current injected into the electrode under test.Two earth stakes are placed in the soil in a direct line away from the electrode of interest, usually spacing of 20 meters is sufficient. The clamp meter is connected to the electrode and the Earth Ground Clamp meter is placed around the electrode to eliminate the effects of parallel resistances in a ground system. This allows only the earth electrode of interest to be measured.3. Soil resistivity earth ground testThe soil resistivitymeasurement method uses four stakes and is typically used before installing an earthing arrangement. The soil composition, moisture content, and temperature all impact the resistance measurements youll see, so this testing is necessary to determine the design when installing a new grounding system. Taking these steps to check out the site before figuring out the layout or building begins. Ideally, youd want to find a location with the lowest possible resistance to work with. This is also used to reassess an environment after, for example, a drought.To test soil resistivity, connect the Fluke 1625-2 to four stakes in the ground. The earth ground tester will generate a known current through the outer two stakes and the inner two will measure any drop in voltage potential. The tester then automatically calculates soil resistance using Ohms law.4. Fall of Potential earth ground testFall of potential measurement uses two stakes and the electrode under test to prove the correct installation of a system, check the grounding system thats already in place before building, or this type of test can be used as part of a continued maintenance program.To run a test with this method, you first have to make sure the ground electrode of interest is disconnected from the site. Once thats done you place two earth stakes in the soil in a direct lineline them up away from the earth electrode of interest, usually 20 meters apart is sufficient.The 1625-2 will generate a known current between the outer stake and the ground electrode while the inner stake measures for any drop in voltage potential.Ground testing requirementsIdeally, the ground resistance of a system is zero ohms, but in reality, this isnt always achievable. Both the National Fire Protection Association (NFPA) and IEEE recommend a ground resistance value of 5.0 ohms or less. But, when you dive further into the National Electric Code (NEC), section 250.56 says that you want to make sure the system to ground is 25.0 ohms or less. In facilities with sensitive equipment, it should be 5.0 ohms or less. It all boils down to a goal of achieving the lowest ground resistance possible that makes sense economically and physically.The NEC also requires a minimum electrode length of 2.5 meters (8 feet) to be in contact with the soil in order to have a ground resistance system. But there are also four variables that affect ground resistance in a ground system:Length / Depth of the ground electrode: double the length, reduce ground resistance by up to 40%Diameter of the ground electrode: double the diameter, lower ground resistance by only 10%Number of ground electrodes: for increased effectiveness, space additional electrodes at least equal to the depth of the ground electrodesGround system design: single ground rod to ground plateEach electrode must also be the proper spacing between them to reduce or eliminate their spheres of influence. This will vary depending on the size and shape of the conducting material. The proper distance apart ensures the test stakes are not influenced by one another, or a ground system under test.What is ground resistance testing? It is a test done to measure the resistance between a grounding electrode and earth. Specialized earth testers, like the Fluke 1630-2 FC Earth Ground Clamp and the Fluke 1625-2 GEO Earth Ground Tester, are the troubleshooting tools built to make earth ground tests a lot easier. How do you perform ground testing? Depending on the situation youre in and what kind of ground setup youre looking at, there are four different methods of testing earth ground resistance available.1. Stakeless earth ground testingStakeless testing uses only two clamps, one as a signal generator and one as a receiver, or one clamp like the 1630-2 FC, to make the measurements . It entirely eliminates the need for temporary ground stakes and is very useful when stakes cant be driven into the ground. It also eliminates the dangerous and time-consuming process of disconnecting parallel grounds and finding a safe place to drive the stakes.The stakeless method is the preferred method when parallel grounds are present and temporary ground stakes would be difficult to be driven in the ground. The stakeless method can be done with just one tool: the 1630-2 Earth Ground Clamp. Just clamp in on and measure away. You can use it both as a voltage generator and an amp clamp in one jaw. Plus, you can measure for low leakage current in a building at the same time.You can also use this method with two clamps attached to a 1625-2. The first clamp is placed around the ground conductor and generates a voltage. The second clamp measures the current flowing due to the voltage generated from the first clamp.2. Selective earth ground testingThe selective testing method uses one clamp and two stakes. It allows you to measure the ground resistance at specific parts of an installation, isolating the system to check or reference whats in place.The selective testing method uses a current clamp while the electrode of interest is still under test. The clamp meter, like a Fluke 1625-2, is used to isolate the test current injected into the electrode under test.Two earth stakes are placed in the soil in a direct line away from the electrode of interest, usually spacing of 20 meters is sufficient. The clamp meter is connected to the electrode and the Earth Ground Clamp meter is placed around the electrode to eliminate the effects of parallel resistances in a ground system. This allows only the earth electrode of interest to be measured.3. Soil resistivity earth ground testThe soil resistivitymeasurement method uses four stakes and is typically used before installing an earthing arrangement. The soil composition, moisture content, and temperature all impact the resistance measurements youll see, so this testing is necessary to determine the design when installing a new grounding system. Taking these steps to check out the site before figuring out the layout or building begins. Ideally, youd want to find a location with the lowest possible resistance to work with. This is also used to reassess an environment after, for example, a drought.To test soil resistivity, connect the Fluke 1625-2 to four stakes in the ground. The earth ground tester will generate a known current through the outer two stakes and the inner two will measure any drop in voltage potential. The tester then automatically calculates soil resistance using Ohms law.4. Fall of Potential earth ground testFall of potential measurement uses two stakes and the electrode under test to prove the correct installation of a system, check the grounding system thats already in place before building, or this type of test can be used as part of a continued maintenance program.To run a test with this method, you first have to make sure the ground electrode of interest is disconnected from the site. Once thats done you place two earth stakes in the soil in a direct lineline them up away from the earth electrode of interest, usually 20 meters apart is sufficient.The 1625-2 will generate a known current between the outer stake and the ground electrode while the inner stake measures for any drop in voltage potential.Ground testing requirementsIdeally, the ground resistance of a system is zero ohms, but in reality, this isnt always achievable. Both the National Fire Protection Association (NFPA) and IEEE recommend a ground resistance value of 5.0 ohms or less. But, when you dive further into the National Electric Code (NEC), section 250.56 says that you want to make sure the system to ground is 25.0 ohms or less. In facilities with sensitive equipment, it should be 5.0 ohms or less. It all boils down to a goal of achieving the lowest ground resistance possible that makes sense economically and physically.The NEC also requires a minimum electrode length of 2.5 meters (8 feet) to be in contact with the soil in order to have a ground resistance system. But there are also four variables that affect ground resistance in a ground system:Length / Depth of the ground electrode: double the length, reduce ground resistance by up to 40%Diameter of the ground electrode: double the diameter, lower ground resistance by only 10%Number of ground electrodes: for increased effectiveness, space additional electrodes at least equal to the depth of the ground electrodesGround system design: single ground rod to ground plateEach electrode must also be the proper spacing between them to reduce or eliminate their spheres of influence. This will vary depending on the size and shape of the conducting material. The proper distance apart ensures the test stakes are not influenced by one another, or a ground system under test. Earth resistance test should be carried out in timely as quarterly basis because with time the lack of moisture the soil resistivity can be increase as above 2 ohm. High resistance is the cause of interruption of current flow in quickly so resistance value should be less then 2 ohm. So in tis way the earth resistance test is required in timely. The earth electrode resistance value should be less than 2 ohm. For better performance of earth electrode, the value of earth resistance should be minimum if the value is more than 2 ohm then short circuit current will not flow quickly. During fault condition current should be travel quickly into ground through earth electrode. So in this way we can say earth resistance value should be check timely as quarterly basis. 2- Earth Pit Testing diagram: 3- Earth Pit Testing Kit: Testing kit is the set of testing meter and other supported accessories which below mentioned. Testing meter: 1 Nos. Iron electrode(spike): 2 Nos. Hammer: 1 nos Testing wire: 1.5 Sq.mm 30 meters or according requirement. Measuring tap : 20 Mtrs. 4- Safety guidelines before earth pit Resistance Test: Earth electrode should be disconnect from electrical panel or equipment. Testing iron electrode distance should be 10 mtrs between testing electrode and earth electrode. Testing meter battery should be fully charged because due ot low battery the testing value can be hampered. Earth electrode thimble should be clean properly with emery paper. 5- Earth Pit Testing Procedure: disconnect the panel earth wire from earth electrode in earth pit. Measure the 10 mtrs distance from earth pit left side and opposite right side. Put and insert testing iron electrode P2 inside the ground at the point of 10 mtrs distance left side from earth pit. Put and insert testing iron electrode E2 inside the ground at the point of 10 mtrs distance right side from earth pit. Testing meter P1 and E1 both points are connected to the ground earth electrode. Testing meter P2 point is connected with P2 testing electrode which has left side grounded from earth pit. Testing meter E2 point is connected with E2 testing electrode which has right side grounded from earth pit. After all connections the red tes button of meter is pressed continue just second. Read the measured value on meter display. If the value or resistance is below 2 ohm then the earth pit electrode is normal. The tested value is more than 2 ohm then the after rechecking all connections the testing procedure should be done again. 6- Eath Pit test Value Observation: Testing parameters are noted down. If the resistance value is below 1 ohm then it is perfect. If the resistance value is below 2 ohm then is satisfactory.> If the value is above 2 ohm then it is maintenance required. If the value is more than 5 ohm then it is re Construction required. Go back to index A Megger, or Megohmmeter (also known as Megger earth tester), is a specialized instrument commonly used for insulation resistance testing, but it can also be employed for measuring ground resistance and testing the earthing or grounding system to ensure that it is within acceptable limits and working properly. Meggers are particularly useful for assessing the integrity of electrical insulation and grounding systems. Heres a step-by-step guide on how to measure ground resistance using a analog and digital Megger earth testers: According to NEC 250.56, the maximum grounding resistance is 25 ohms, and 50 ohms for sensitive applications. An additional ground rod needs to be installed if the ground resistance exceeds 50 ohms.According to IEC/BS EN 62561-2:2012, good earth resistance is 5 10 ohms.Recommended grounding resistance per IEEE and NFPA standards is typically < 5 ohms, also applicable to telecommunications. Before proceeding, disconnect the earth lead / ground wire from the main distribution board / main panel when testing the ground resistance. Ensure that you are familiar with the specific model and features of your Megger earth tester, and follow the manufacturers instructions. Additionally, make sure to observe proper safety precautions, especially when working with electrical systems. The author will not be liable for any losses, injuries, or damages resulting from the display or use of this information or any attempt to implement a circuit in the incorrect format. Therefore, exercise caution, as working with electricity poses inherent risks. Clamp a ground meter around the grounding electrode conductor and turn it on. A reading under 25 ohms generally means the ground rod has a good connection to the earth.Use an Earth Electrode tester by connecting 1 lead to the top of the ground rod and the remaining 2 to a set of ground rods at least 10 times the length of the ground rod away.Reduce ground system resistance by ensuring the clamp that connects the ground rod and the grounding circuit conductor is very tight.1Get a clamp-on ground meter. A clamp-on ground meter is a specialized electronic machine that checks electrical resistance. You can only use this type of meter to check resistance in a multi-grounded system, not on an isolated ground rod.[1] Keep in mind that while this is the easiest method, it's also the least accurate.[2]The clamp-on meter will give you a reading in "ohms," which is the unit of measurement for resistance. It may be signified with the symbol "" on the meter.A clamp-on meter allows you to check the resistance of an installed ground rod without disconnecting it from the electrical supply.[3]Working with electricity can be dangerous! If you don't have the right tool or aren't sure how to use it, contact an experienced electrician or lineman for help. 2Clamp the meter on the ground rod. Open the clamp by pressing the lever on the side of the meter and holding it down. Then put the clamp around the grounding electrode conductor or the top of the ground rod. Let the clamp close by letting go of the lever.[4]Clamp the meter near the ground rather than at the top of the rod. Advertisement 3Turn on the meter. How you start the meter depends on the specific brand you have. Some simply have a button that says "power" or "on."[5] Others have a dial that needs to be set to ohms.4Check the resistance reading on the meter. Your clamp-on ground tester will have a screen that will show you a numeric reading.[6] The lower the number on the meter, the better your grounding rod is working. In general, a reading under 25 ohms means that your ground rod has a good connection to the earth.[7] Advertisement 1Get an earth electrode tester. This is an older type of resistance meter that uses multiple ground probes and wires to assess a ground rod's resistance. This type of tester is usually available at hardware and home improvement stores, as well as from online retailers.Using an earth electrode tester instead of a clamp-on tester will take a lot more time and effort. If you have the option of using a clamp-on meter, use the clamp-on meter.2Insert 2 ground probes into the ground. The ground probes need to be inserted into the ground at specific distances away from the ground rod. The furthest ground probe needs to be at a distance that is 10 times the length of the ground rod. For instance, if the ground rod is 8 feet (2.4m) long, the furthest probe should be 80 feet (24m) away. The second ground rod should be located halfway between the furthest probe and the ground rod.[8]The ground probes are typically about 1 foot (0.30m) long. They should be inserted into the ground until the top of them is just visible.The leads that come with earth electrode testers are typically very long, so they should reach the required distance.3Connect all three leads. The three leads your meter comes with should be inserted into the openings on the meter. Then, the other end of 1 of the leads needs to be connected to the top of the ground rod. The other 2 each need to be connected to one of the ground probes.In general, it doesn't matter which lead goes to which ground rod or probe. However, the lead for the furthest ground probe should be the longest one so that it will reach.4Turn on the meter and take a reading. How you turn on the meter depends on the specific type of meter you have. Most have a dial that should be set to the ohm symbol or to a mark that says "3 pole," which is referencing your 3 points of contact with the earth. Once the meter is on, read what the screen says.If a ground rod has a good connection to ground, its reading should be a number below 25.[9]5Verify your original reading. Move one of your probes to a location 2 feet (0.61m) closer to the ground rod. Take a reading of the resistance once again. Then move that same probe so it is 2 feet (0.61m) closer to the second probe than it was originally. Take another reading. All the readings that you get should be very similar.[10]To ensure that your ground rod is sufficient, the average of all 3 readings should be less than 25 ohms. Advertisement 1Make sure the grounding system connections are secure. If you don't get a satisfactory ground reading, check your grounding system for problems. Make sure the clamp that connects the ground rod and the grounding circuit conductor is very tight. Also ensure that the ground electrode conductor is solidly connected to the grounding bar in the electrical panel.Most electrical systems also have secondary grounding means, such as the grounding bar being connected to a cold water pipe that goes into the ground. Make sure that the secondary grounding means is also securely connected.2Install a new ground rod in a different location. In some instances, ground rods can be installed in areas where the earth has a lot of resistance. For instance, if a ground rod is driven into a very rocky and dry area it may not conduct electricity into the ground well. If this is the case for your ground rod, the best solution is to drive a different rod into a different location.This may not require you to put a ground rod a long distance away from the original rod. Even a few feet can make a difference for the ground resistance.3Install a second ground rod. If you have too much resistance in your initial ground rod, you can connect a second one in series to reduce the overall resistance. This will ensure that any ground fault will be able to go to ground easily. Your second ground rod should be located at a distance that is equal to the length of your ground rod. For example, if your first ground rod is 8 feet (2.4m) long, your second ground rod should be located 8 feet (2.4m) from the first ground rod. Advertisement Add New Question Question I replaced a 16V transformer for a doorbell, that was mounted on my electric panel box. The old transformer had no ground wire, but the new one does. Can I drill a hole in the box to attach the ground? No, you would generally need to run the equipment grounding conductor (EGC) in the same cable as the line and neutral conductors that supply the transformer in its new location, terminating all three conductors inside a junction box. The EGC wire would then attach to the transformer's wire as well as the junction box, if the box is metal. You could also use properly installed metallic conduit as the EGC path to ground. Question In the article, How to test a ground rod under reducing ground system resistance it states to place an additional rod 8ft from an 8ft long rod. This is incorrect. It should be twice that. In NEC (2014): 250.53(A)(3) and 250.53(B) seem to say additional electrode rods shall "not be less than 1.83 m (6 feet) apart". However, it is noted that the "paralleling efficiency is increased by spacing them twice the length of the longest rod." Question Is the ground slot on electrical outlets live? Yes, the grounded slot in electrical outlets is "live" in the sense that it is intended to conduct the power used by devices plugged into it, same as the "hot" slot. It also happens to be grounded at the service panel, if done properly, as is the grounding slot in a three-slot receptacle. The grounding conductor is, however, intended for safety from electrocution, not to carry any significant power during normal use. See more answers Ask a Question Advertisement Co-authored by: Electrician & Construction Professional, CN Coterie This article was co-authored by Ricardo Mitchell. Ricardo Mitchell is the CEO of CN Coterie, a fully licensed and insured Lead EPA (Environmental Protection Agency) Certified construction company located in Manhattan, New York. CN Coterie specializes in full home renovation, electrical, plumbing, carpentry, cabinetry, furniture restoration, OATH/ECB (Office of Administrative Trials and Hearings/Environmental Control Board) violations removal, and DOB (Department of Buildings) violations removal. Ricardo has over 10 years of electrical and construction experience and his partners have over 30 years of relevant experience. This article has been viewed 145,781 times. Co-authors: 8 Updated: August 21, 2024 Views:145,781 Categories: Electrical Safety PrintSend fan mail to authors Thanks to all authors for creating a page that has been read 145,781 times. Thousands of people die every year due to fire eruptions and electrocution caused by short circuits or lightning strikes. Most of these short circuits are caused by the usage of low-quality wires, substandard wire fittings, or compromised maintenance of electrical infrastructures. To eliminate the likelihood of such unfortunate events, it is crucial to find an alternative that minimizes the impact of current leakages and short circuits into the ground. The technique used is called grounding. Ground resistance is the most important quantity used to calculate the current the ground can dissipate. To measure ground resistance, industry experts consult with Grounding Resistance Testing Methods issued and trusted by IEEE. This blog post will discuss the three most practical and proven Grounding Resistance Testing Methods along with IEEE standards related to testing ground resistance. Lets cover each of these in detail. We are going to cover the following three methods used for testing ground resistance. Equally spaced 4-pin Method Unequally spaced 4-pin Method Driven Rod Method Wenner equally spaced 4-pin method is one the most preferred ground resistance testing method. 4 electrodes of equal length I are driven in a straight line at an equal distance a. The voltage between inner probes is measured. The current between outer probes is measured. Resistance and resistivity are calculated as shown below. This is the modified approach of Wenners ground resistance testers to provide higher sensitivity for large spacing. 4 electrodes of equal length l are driven in a straight line, as shown below. The voltage between inner probes is measured. The current between outer probes is measured. Resistance and resistivity are calculated as shown below. This is based on the Fall-of-Potential approach and one of the most effective grounding resistance testing methods. The test rod has a diameter of d, and it is driven into the ground to a length of I. Reference rods are driven to a shallow length in a straight line. Current is measured between Rod 1 and Rod 2. Voltage is measured between Rod 1 and Rod 3. As discussed earlier, Grounding or Earthing is an approach for electrical circuits integrated into the ground. It enables the dissipation of current leakage when electricity is discharged to the earth. This method is effective in eliminating the likelihood of any short circuit caused by wire or current leakage in the ground. Since Grounding Resistance Testing is one of the core aspects of grounding, IEEE documented a set of guidelines and procedures to measure ground resistance as well as ground potential for a grounding system. In power systems engineering, whether you are preparing for your PE Power exam or need references in your professional domain, It is recommended to consult the below three IEEE Grounding Standards. Initially put forward in 1961, IEEE standard 80 deals with the grounding of outdoor AC substations. According to the surveys, globally over 80% of utility engineers rely on a ground-grid design by ensuring IEEE Standard 80. The latest amendments in the document further support users in further understanding ground grid design and its deployment across the globe. The set of guidelines compiled in IEEE standard 80 ensures secure grounding practices for primarily outdoor AC substations. These AC substations are to be used for power distribution and transmission. Whereas some instances of IEEE 80 can also be adapted for indoor grounding. This IEEE standard covers the procedures and standards used for the measurement of soil resistivity and grounding impedance of grounded systems. Ground resistance testers are primarily used at lightning protection systems, AC substations, and industrial plants. The purpose is intended to safeguard expensive commercial or public equipment from potential hazards. The US National Electric Code specifies that each substation must possess at least one grounding rod to protect the substations by: Ensuring that lightning strikes refrain from causing any potential damage to the system. Ensuring that an unwanted current from the neutral must not mistake a person standing close to the grid as the grounding rod. Otherwise, a person can be electrocuted. These challenges can be addressed by setting up an efficient grounding system for the substation as per the guidelines instructed by IEEE standard 81. After the installation of a grounding system, it can be tested using the IEEE Variation of depth method discussed above. IEEE Standard 142 signifies the guidelines related to the design and practical aspects of grounding. An efficient design and deployment of an industrial-grade grounding system is undoubtedly a complex task. To ease this process, IEEE Standard 142 has documented all the necessary knowledge that experts need to produce an effective grounding system. The references used in the document are remarkable and evident in their authority and technical proximity. The IEEE Standard 142 is applicable to all industrial-scale grounding infrastructures and helps you decide on the right type of grounding to use in a particular scenario. Ground resistance testing is a crucial procedure for ensuring electrical safety. However, even with careful preparation, unexpected issues can arise during testing. This section provides common troubleshooting tips to address challenges and ensure accurate ground resistance measurements. One frequent hurdle is encountering unexpected test results. High resistance readings could indicate a poorly grounded system, dry soil conditions, or a faulty connection between the grounding electrode and the earth. Conversely, abnormally low readings suggest a grounding loop or an issue with the tester. Consulting the manufacturers instructions for your specific tester can help interpret readings outside the expected range. Another potential issue is equipment malfunction. Testers can malfunction due to low battery levels, damaged probes, or internal component failures. Verifying fresh batteries are installed and visually inspecting probes for wear or tear are essential first steps. Most testers offer basic self-test functions; consult the user manual to ensure proper operation before testing. Finally, challenging site conditions can present difficulties. Rocky terrain or frozen soil can make driving in grounding rods or establishing proper probe contact hard. In such cases, alternative testing methods like the fall-of-potential method might be necessary. This method utilizes auxiliary grounding rods and requires specific calculations to determine ground resistance. Consulting a qualified electrician for guidance in these situations is recommended. Grounding Resistance Testing Methods discussed in this blog post are vital in determining the design and ensuring the proximity of the grounding system. The goal is to help experts in finding the perfect deployment location having the least possible resistance. The process depends upon calculating the resistivity factor of ground or soil, which may vary depending on various factors like the temperature and moisture on the deployment site. Therefore, the inconsistent nature of soil resistivity in different geographics makes Ground Resistance Testing the most crucial approach in saving the electrical infrastructure as well as safeguarding human life. What is ground resistance testing? It is a test done to measure the resistance between a grounding electrode and earth. Specialized earth testers, like the Fluke 1630-2 FC Earth Ground Clamp and the Fluke 1625-2 GEO Earth Ground Tester, are the troubleshooting tools built to make earth ground tests a lot easier. How do you perform ground testing? Depending on the situation youre in and what kind of ground setup youre looking at, there are four different methods of testing earth ground resistance available.1. Stakeless earth ground testingStakeless testing uses only two clamps, one as a signal generator and one as a receiver, or one clamp like the 1630-2 FC, to make the measurements . It entirely eliminates the need for temporary ground stakes and is very useful when stakes cant be driven into the ground. It also eliminates the dangerous and time-consuming process of disconnecting parallel grounds and finding a safe place to drive the stakes.The stakeless method is the preferred method when parallel grounds are present and temporary ground stakes would be difficult to be driven in the ground. The stakeless method can be done with just one tool: the 1630-2 Earth Ground Clamp. Just clamp in on and measure away. You can use it both as a voltage generator and an amp clamp in one jaw. Plus, you can measure for low leakage current in a building at the same time.You can also use this method with two clamps attached to a 1625-2. The first clamp is placed around the ground conductor and generates a voltage. The second clamp measures the current flowing due to the voltage generated from the first clamp.2. Selective earth ground testingThe selective testing method uses one clamp and two stakes. It allows you to measure the ground resistance at specific parts of an installation, isolating the system to check or reference whats in place.The selective testing method uses a current clamp while the electrode of interest is still under test. The clamp meter, like a Fluke 1625-2, is used to isolate the test current injected into the electrode under test.Two earth stakes are placed in the soil in a direct line away from the electrode of interest, usually spacing of 20 meters is sufficient. The clamp meter is connected to the electrode and the Earth Ground Clamp meter is placed around the electrode to eliminate the effects of parallel resistances in a ground system. This allows only the earth electrode of interest to be measured.3. Soil resistivity earth ground testThe soil resistivitymeasurement method uses four stakes and is typically used before installing an earthing arrangement. The soil composition, moisture content, and temperature all impact the resistance measurements youll see, so this testing is necessary to determine the design when installing a new grounding system. Taking these steps to check out the site before figuring out the layout or building begins. Ideally, youd want to find a location with the lowest possible resistance to work with. This is also used to reassess an environment after, for example, a drought.To test soil resistivity, connect the Fluke 1625-2 to four stakes in the ground. The earth ground tester will generate a known current through the outer two stakes and the inner two will measure any drop in voltage potential. The tester then automatically calculates soil resistance using Ohms law.4. Fall of Potential earth ground testFall of potential measurement uses two stakes and the electrode under test to prove the correct installation of a system, check the grounding system thats already in place before building, or this type of test can be used as part of a continued maintenance program.To run a test with this method, you first have to make sure the ground electrode of interest is disconnected from the site. Once thats done you place two earth stakes in the soil in a direct lineline them up away from the earth electrode of interest, usually 20 meters apart is sufficient.The 1625-2 will generate a known current between the outer stake and the ground electrode while the inner stake measures for any drop in voltage potential.Ground testing requirementsIdeally, the ground resistance of a system is zero ohms, but in reality, this isnt always achievable. Both the National Fire Protection Association (NFPA) and IEEE recommend a ground resistance value of 5.0 ohms or less. But, when you dive further into the National Electric Code (NEC), section 250.56 says that you want to make sure the system to ground is 25.0 ohms or less. In facilities with sensitive equipment, it should be 5.0 ohms or less. It all boils down to a goal of achieving the lowest ground resistance possible that makes sense economically and physically.The NEC also requires a minimum electrode length of 2.5 meters (8 feet) to be in contact with the soil in order to have a ground resistance system. But there are also four variables that affect ground resistance in a ground system:Length / Depth of the ground electrode: double the length, reduce ground resistance by up to 40%Diameter of the ground electrode: double the diameter, lower ground resistance by only 10%Number of ground electrodes: for increased effectiveness, space additional electrodes at least equal to the depth of the ground electrodesGround system design: single ground rod to ground plateEach electrode must also be the proper spacing between them to reduce or eliminate their spheres of influence. This will vary depending on the size and shape of the conducting material. The proper distance apart ensures the test stakes are not influenced by one another, or a ground system under test.When conducting a grounding audit of a central office there are three different measurements required using an earth tester. Before testing, locate the MGB (Master Ground Bar) within the central office to determine the type of grounding system that exists. As shown on this page, the MGB will have ground leads connecting to the:MGN (Multi-Grounded Neutral) or incoming serviceGround fieldWater pipeStructural or building steel1. Perform stakeless test on all individual groundsFirst, perform the stakeless test on all the individual grounds coming off of the MGB. The purpose is to ensure that all the grounds are connected, especially the MGN. It is important to note that you are not measuring the individual resistance, rather the loop resistance of what you are clamped around. As shown in Figure 1, connect the Fluke1625 Earth Tester or 1623 Earth Ground Resistance Meteras well as the inducing and sensing clamps, which are placed around each connection to measure the loop resistance of the MGN, the ground field, the water pipe, and the building steel.2. Perform the 3-pole fall-of-potential testSecond, perform the 3-pole fall-of-potential test of the entire ground system, connecting to the MGB as illustrated on in Figure 2. To get to remote earth, many phone companies utilize unused cable pairs going out as much as a mile. Record the measurement and repeat this test at least annually.3. Measure the indvidual resistances of the ground systemThird, measure the individual resistances of the ground system using the selective test of the Fluke 1625 or 1623. Connect the Fluke earth tester, as shown in Figure 3. Measure the resistance of the MGN; the value is the resistance of that particular leg of the MGB. Then measure the ground field. This reading is the actual resistance value of the central office ground field. Now move on to the water pipe, and then repeat for the resistance of the building steel. You can easily verify the accuracy of these measurements through Ohm's Law. The resistance of the individual legs, when calculated, should equal the resistance of the entire system given (allow for reasonable error since all ground elements may not be measured).These test methods provide the most accurate measure of a central office, because it gives you the individual resistances and their actual behavior in a ground system. Although accurate, the measurements would not show how the system behaves as a network, because in the event of a lightning strike or fault current, everything is connected.To prove this, you need to perform a few additional tests on individual resistances.First, perform the 3-pole fall-of-potential test on each leg off the MGB and record each measurement. Using Ohm's Law again, these measurements should be equal to the resistance of the entire system. From the calculations you will see that you are from 20 % to 30 % off the total RE value.Finally, measure the resistances of the various legs of the MGB using the selective stakeless method. It works like the stakeless method, but it differs in the way we use the two separate clamps. We place the inducing voltage clamp around the cable going to the MGB, and since the MGB is connected to the incoming power, which is parallel to the earth system, we have achieved that requirement. Take the sensing clamp and place it around the ground cable leading out to the ground field. When we measure the resistance, this is the actual resistance of the ground field, plus the parallel path of the MGB. And because it should be very low ohmically, it should have no real effect on the measured reading. This process can be repeated for the other legs of the ground bar i.e. water pipe and structural steel.To measure the MGB via the stakeless selective method, place the inducing voltage clamp around the line to the water pipe (since the copper water pipe should have very low resistance) and your reading will be the resistance for only the MGN.

What is earth resistance test. Earth ground test. Earth resistance testing procedure. Earth resistance test results. Earth resistance tester. Ground resistance test procedure. Ground resistance testing.