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Megger testing is a type of electrical test that evaluates how well insulation performs in a partof electrical equipment. A voltage is provided, and then a mega-ohm meteris used to measure the resistance of each phase connection between the motor leads and the ground. Check the level of electrical insulation in any device, such a motor, cable, or transformer, to determine how much electrical leakage there is in the wire. This can be done by passing the current through the devices initially. The magnitude of the effect of this can be expressed in terms of (M)mega ohms. It is necessary to have 1000V to 5000V for thetesting purposes when working with electrical systems that have a high voltage. The connection of the deflecting coil needs to be in series in order for the current to flow and function properly throughout the circuit. A power supply coil is placed in the middle of this connection to complete the circuit. Both the Current Coil Resistor and the Pressure Coil Resistor are linked in series with each other so that the circuit can be shielded from any potential damage. Using the use of two coils, such as a control coil and a deflecting coil. An EMI effect will produce a test voltage when it is applied to a megger that is operated by hand. When the voltagegets increases, the deflection pointer will show that it has increased all across to infinity. In the same way, if the current makes the deflection greater,the pointer remains at zero. 1). The Megger Instrument must be calibrated. 2). A megger with a range of 500V/1000V must be used to conduct the test. Wire testing shall be performed using a 500 V megger. For cable testing, a megger with a range of 1000 V needs to be utilised.The leads that are used to connect the megger to the circuit need to be free of any faults, and the two leads that are used to connect the megger need to have electrical continuity. It is checked by connecting the free ends ofleads together and contacting them while simultaneously pressing the ON button on the megger in order to check for a resistance of zero. PVC adopters are included for cables, along with male adaptors for any and all PVC conduits that terminate inpanel board. Make sure that the insulation has been applied to each and every wire in the panel boards. Before starting the testing, make sure that all of the connections have been completed. Connect the free test probes to the anytwo wires that need to be checked with the megger. For Wires: When all of the devices are connected, both ends of the conductors are shorted, and all of the switches are turned on, the reading that is displayed on the megger must be zero. If the reading indicates that there is no limit, then the circuit is open. It is necessary to identify the source of the problem and correct it. For Cables: In the case of cables, the outermost ends of any two phases should be shorted, and the reading should be zero when the test is carried out; if the meterreads infinity or some number of mega ohms, this indicates that there is a fault incable, and it ought to be fixed as soon as possible. The exact same process needs to be repeated for the cables other three conductors. For Wires: The voltage range on the Megger should be set to 500V when testing the circuits wires Between neutral and phase From the phase to the earth From neutral to earth The value should be infinity during the entire test with each of the other ends of circuit conductor open. If the result is 0, there has been a short circuit (or)the wires insulation has been damaged, in which case the wire should be replaced. For Cables: The Megger range for cables needs to be 1000V, & both ends of the cable must be left open during testing between the phases and neutrals. Between Phase-to-Phase Between Phase-to-Neutral All of these readings supposed tobe infinity; if they are not, the cables conductors and phases are defective and need to be fixed. Recording the findings of the tests in a way that can be referred to and used by engineers is required. Before starting the megger test operation, the format needs to be authorised by the Consultant. This must be done before the process gets started. In order to properly test the insulation, detach from the panel (or)equipment and then ensure that they remain isolated from the electrical supply. With the use of a ground (E) cable, thecables need to be checked against one another (phase to phase). Formula for determining minimum insulation resistance values is provided by the Insulated Power Cable Engineers Association (UPCEA). R=K X Log10(D/d) Where, R=IR Value expressed in M for every 305 metres (1000 feet) of cable. K =Constant for the insulation material (Varnished Cambric = 2460, Thermoplastic Polyethylene = 50000Compositepolythene 30000) K =Constant for the insulation material (Varnished Cambric = 2460, Thermoplastic Polyethylene = 50000Compositepolythene 30000) D Outside diameter of the conductor insulation for single-conductor wire and cable (D=d+2c+2b =diameter of a single-conductor cable). d -size of the conductors diameter c thickness of the insulation surrounding the conductors b thickness of the insulation surrounding the outer-sheath Coaxial cables are essential components of many communication and data transmission systems. To ensure that these cables function properly, its important to regularly test their insulation integrity. A Megger insulation tester, also known as a megohmmeter or insulation resistance tester, is a valuable tool for this purpose. In this article, we will guide you through the process of testing coaxial cables with a Megger insulation tester. Coaxial cables consist of a central conductor, an insulating layer, a metallic shield, and an outer insulating layer. The insulation is crucial for maintaining the cables electrical and mechanical performance. Over time, the insulation can degrade due to environmental factors, moisture, physical damage, or wear and tear. To prevent signal loss, data corruption, and potential safety hazards, it is necessary to test the insulation integrity of coaxial cables. Megger insulation tester: A high-quality Megger insulation tester with appropriate test voltage settings (typically 500 VDC or 1000 VDC). Coaxial cable to be tested. Safety gear: Safety goggles and gloves to ensure your safety when working with electrical equipment. A clean, dry, and well-ventilated testing environment.Safety Precautions:Ensure that you are working in a safe environment, and that all necessary safety gear is worn. Make sure the coaxial cable is not connected to any live electrical circuits. Preparation:Unplug the coaxial cable from any connected devices or systems. Visually inspect the cable for any visible damage or wear. Replace damaged cables as needed. Connect the Megger Tester:Connect the Megger testers positive lead (red) to the central conductor of the coaxial cable. Connect the negative lead (black) to the outer metallic shield of the cable. Ensure that the leads make proper contact with the cable components. Set the Test Voltage:Set the Megger tester to the appropriate test voltage, typically 500 VDC or 1000 VDC. The test voltage depends on the cables specifications and the insulation material used. Initiate the Test:Turn on the Megger insulation tester. Start the insulation resistance test. The tester will apply the specified voltage to the cable and measure the resistance of the insulation. Record the Reading:The Megger tester will display the insulation resistance value in ohms or megohms (or M). Record this value for future reference.Insulation Test Coaxial Cable The insulation resistance value you obtain from the Megger tester is a measure of the coaxial cables insulation integrity. The value should be compared to the manufacturers specifications for the cable. In general, a higher insulation resistance indicates better cable insulation. If the measured resistance is close to or within the manufacturers specified range, the cable is considered to have good insulation. If the measured resistance is significantly lower than the manufacturers specifications or has a value close to zero, this indicates a potential insulation fault or breakdown. In this case, the cable may need replacement or repair. If the resistance is borderline, it is advisable to conduct additional tests over time to monitor any further degradation. Testing coaxial cable insulation with a Megger insulation tester is a critical maintenance procedure to ensure the reliable operation of communication and data transmission systems. By following the steps outlined in this guide, you can assess the condition of your coaxial cables and take appropriate action if any insulation issues are detected. Regular testing and maintenance will help extend the lifespan of your coaxial cables and prevent potential signal loss or data corruption. In todays ever-evolving world, security and safety are paramount concerns, and keeping up with the latest standards and practices is crucial. If youre eager to explore the realm of security alarms and aspire to gain recognised qualifications, then our UK government-approved security alarm course accredited by EAL is the perfect path for you. By enrolling in this course, youre not only investing in your own knowledge and skills but also contributing to the overall security of our communities. Youll be equipped with the expertise needed to install, maintain, and troubleshoot security alarm systems, and youll gain a prestigious accreditation from EAL, a trusted awarding body. For more information about our security alarm course, accreditation, and how it can enhance your career prospects, we invite you to get in touch with us today. Our knowledgeable and friendly team is here to answer all your queries, guide you through the enrollment process, and help you take the first step toward a rewarding and secure future. Dont miss this opportunity to become a certified security alarm professional. Contact us now, and let us help you embark on this exciting journey of learning and professional growth. Your security career begins here! Article by: Fire and Security Alarm Consultant The measurement of insulation resistance is a common routine test performed on all types of electrical wires and cables. As a production test, this test is often used as a customer acceptance test, with minimum insulation resistance per unit length often specified by the customer. The results obtained from IR Test are not intended to be useful in finding localized defects in the insulation as in a true HIPOT test, but rather give information on the quality of the bulk material used as the insulation.Even when not required by the end customer, many wire and cable manufacturers use the insulation resistance test to track their insulation manufacturing processes, and spot developing problems before process variables drift outside of allowed limits.Selection of IR Testers (Megger):Insulation testers with test voltage of 500, 1000, 2500 and 5000 V are available.The recommended ratings of the insulation testers are given below:Voltage LevelIR Tester650V500V DC1.1KV1KV DC3.3KV2.5KV DC66Kv and Above5KV DCTest Voltage for Meggering:When AC Voltage is used, The Rule of Thumb is Test Voltage (A.C) = (2X Name Plate Voltage) +1000.When DC Voltage is used (Most used in All Megger), Test Voltage (D.C) = (2X Name Plate Voltage).Equipment / Cable RatingDC Test Voltage24V To 50V50V To 100V50V To 100V100V To 250V100V To 240V250V To 500V440V To 550V500V To 1000V2400V1000V To 2500V4100V1000V To 5000VMeasurement Range of Megger:Test voltageMeasurement Range250V DC0M to 250G500V DC0M to 500G1KV DC0M to 1T2.5KV DC0M to 2.5T5KV DC0M to 5TPrecaution while Meggering:Before Meggering:Make sure that all connections in the test circuit are tight.Test the megger before use, whether it gives INFINITY value when not connected, and ZERO when the two terminals are connected together and the handle is rotated.During Meggering:Make sure when testing for earth, that the far end of the conductor is not touching, otherwise the test will show faulty insulation when such is not actually the case.Make sure that the earth used when testing for earth and open circuits is a good one otherwise the test will give wrong informationSpare conductors should not be meggered when other working conductors of the same cable are connected to the respective circuits.After completion of cable Meggering:Ensure that all conductors have been reconnected properly.Test the functions of Points, Tracks & Signals connected through the cable for their correct response.In case of signals, aspect should be verified personally.In case of points, verify positions at site. Check whether any polarity of any feed taken through the cable has got earthed inadvertently.Safety Requirements for Meggering:All equipment under test MUST be disconnected and isolated.Equipment should be discharged (shunted or shorted out) for at least as long as the test voltage was applied in order to be absolutely safe for the person conducting the test.Never use Megger in an explosive atmosphere.Make sure all switches are blocked out and cable ends marked properly for safety.Cable ends to be isolated shall be disconnected from the supply and protected from contact to supply, or ground, or accidental contact.Erection of safety barriers with warning signs, and an open communication channel between testing personnel.Do not megger when humidity is more than 70 %.Good Insulation: Megger reading increases first then remain constant.Bad Insulation: Megger reading increases first and then decreases.Expected IR value gets on Temp. 20 to 30 decree centigrade.If above temperature reduces by 10 degree centigrade, IR values will increased by two times.If above temperature increased by 70 degree centigrade IR values decreases by 700 times.How to use Megger:Meggers is equipped with three connection Line Terminal (L), Earth Terminal (E) and Guard Terminal (G).Resistance is measured between the Line and Earth terminals, where current will travel through coil 1. The Guard terminal is provided for special testing situations where one resistance must be isolated from another. Lets us check one situation where the insulation resistance is to be tested in a two-wire cable.To measure insulation resistance from a conductor to the outside of the cable, we need to connect the Line lead of the megger to one of the conductors and connect the Earth lead of the megger to a wire wrapped around the sheath of the cable.In this configuration the Megger should read the resistance between one conductor and the outside sheath.We want to measure Resistance between Conductor- 2To Sheaths but Actually Megger measure resistance in parallel with the series combination of conductor-to-conductor resistance (Rc1-c2) and the first conductor to the sheath (Rc1-s).If we dont care about this fact, we can proceed with the test as configured. If we desire to measure only the resistance between the second conductor and the sheath (Rc2-s), then we need to use the meggers Guard terminal.Connecting the Guard terminal to the first conductor places the two conductors at almost equal potential. With little or no voltage between them, the insulation resistance is nearly infinite, and thus there will be no current between the two conductors. Consequently, the Meggers resistance indication will be based exclusively on the current through the second conductors insulation, through the cable sheath, and to the wire wrapped around, not the current leaking through the first conductors insulation.The guard terminal (if fitted) acts as a shunt to remove the connected element from the measurement. In other words, it allows you to be selective in evaluating certain specific components in a large piece of electrical equipment. For example consider a two core cable with a sheath. As the diagram below shows there are three resistances to be considered.If we measure between core B and sheath without a connection to the guard terminal some current will pass from B to A and from A to the sheath. Our measurement would be low. By connecting the guard terminal to A the two cable cores will be at very nearly the same potential and thus the shunting effect is eliminated.(1) IR Values For Electrical Apparatus & Systems:(PEARL Standard / NETA MTS-1997 Table 10.1)Max.Voltage Rating Of Equipment Megger SizeMin.IR Value 250 Volts500 Volts25 M600 Volts1,000 Volts100 M5 KV2,500 Volts1,000 M8 KV2,500 Volts2,000 M15 KV2,500 Volts5,000 M25 KV5,000 Volts20,000 M35 KV15,000 Volts100,000 M46 KV15,000 Volts100,000 M69 KV15,000 Volts100,000 MOne Meg ohm Rule for IR Value for Equipment:Based upon equipment rating:< 1K V = 1 M minimum>1KV = 1 M /1KVAs per IE Rules-1956:At a pressure of 1000 V applied between each live conductor and earth for a period of one minute the insulation resistance of HV installations shall be at least 1 Mega ohm or as specified by the Bureau of Indian Standards.Medium and Low Voltage Installations- At a pressure of 500 V applied between each live conductor and earth for a period of one minute, the insulation resistance of medium and low voltage installations shall be at least 1 Mega ohm or as specified by the Bureau of Indian Standards] from time to time.As per CBIP specifications the acceptable values are 2 Mega ohms per KV (2) IR Value for Transformer:Insulation resistance tests are made to determine insulation resistance from individual windings to ground or between individual windings. Insulation resistance tests are commonly measured directly in megohms or may be calculated from measurements of applied voltage and leakage current.The recommended practice in measuring insulation resistance is to always ground the tank (and the core). Short circuit each winding of the transformer at the bushing terminals. Resistance measurements are then made between each winding and all other windings grounded.Windings are never left floating for insulation resistance measurements. Solidly grounded winding must have the ground removed in order to measure the insulation resistance of the winding grounded. If the ground cannot be removed, as in the case of some windings with solidly grounded neutrals, the insulation resistance of the winding cannot be measured. Treat it as part of the grounded section of the circuit.We need to test winding to winding and winding to ground (E).For three phase transformers, We need to test winding (L1,L2,L3) with substitute Earthing for Delta transformer or winding (L1,L2,L3) with earthing (E) and neutral (N) for wye transformers.IR Value for Transformer(Ref: A Guide to Transformer Maintenance by. JJ. Kelly. S.D Myer)TransformerFormula1 Phase TransformerIR Value (M) = C X E / (KVA)3 Phase Transformer (Star)IR Value (M) = C X E (P-n) / (KVA)3 Phase Transformer (Delta)IR Value (M) = C X E (P-P) / (KVA)Where C= 1.5 for Oil filled T/C with Oil Tank, 30 for Oil filled T/C without Oil Tank or Dry Type T/C.Temperature correction Factor (Base 20C):Temperature correction FactorOCOFCorrection Factor0320.255410.3610500.5015590.72020681.0030861.98401043.95501227.85Example: For 1600KVA, 20KV/400V,Three Phase TransformerIR Value at HV Side= (1.5 x 20000) / 1600 =16000 / 40 = 750 M at 200CIR Value at LV Side = (1.5 x 400) / 1600= 320 / 40 = 15 M at 200CIR Value at 300C =15X1.98= 29.7 MInsulation Resistance of Transformer CoilTransformer Coil VoltageMegger Size Min.IR Value Liquid Filled T/C Min.IR Value Dry Type T/C0 600 V1KV100 M500 M600 V To 5KV2.5KV1,000 M5,000 M5KV To 15KV5KV5,000 M25,000 M15KV To 69KV5KV10,000 M50,000 MIR Value of Transformers:VoltageTest Voltage (DC) LV side Test Voltage (DC) HV sideMin IR Value415V500V2.5KV100MUp to 6.6KV500V2.5KV200M6.6KV to 11KV500V2.5KV400M11KV to 33KV1000V5KV500M33KV to 66KV1000V5KV600M66KV to 132KV1000V5KV600M132KV to 220KV1000V5KV650MSteps for measuring the IR of Transformer:Shut down the transformer and disconnect the jumpers and lightning arrestors.Discharge the winding capacitance.Thoroughly clean all bushingsShort circuit the windings.Guard the terminals to eliminate surface leakage over terminal bushings.Record the temperature.Connect the test leads (avoid joints).Apply the test voltage and note the reading. The IR. Value at 60 seconds after application of the test voltage is referred to as the Insulation Resistance of the transformer at the test temperature.The transformer Neutral bushing is to be disconnected from earth during the test.All LV surge diverter earth connections are to be disconnected during the test.Due to the inductive characteristics of transformers, the insulation resistance reading shall not be taken until the test current stabilizes.Avoid meggering when the transformer is under vacuum.Test Connections of Transformer for IR Test (Not Less than 200 M): (HV + LV) GNDHV (LV + GND)LV (HV + GND)Three winding transformer:HV (LV + TV + GND)LV (HV + TV + GND)(HV + LV + TV) GNDTV (HV + LV + GND)Auto transformer (two winding):Auto Transformer (three winding):(HV + LV) (TV + GND)(HV + LV + TV) GNDTV (HV + LV + GND)For any installation, the insulation resistance measured shall not be less than:HV Earth 200 M LV Earth 100 M HV LV 200 M Factors affecting on IR value of TransformerThe IR value of transformers are influenced bysurface condition of the terminal bushingquality of oilquality of winding insulationtemperature of oilduration of application and value of test voltage(3) IR Value for Tap Changer:IR between HV and LV as well as windings to earth.Minimum IR value for Tap changer is 1000 ohm per volt service voltage(4) IR Value for Electric motor:For electric motor, we used a insulation tester to measure the resistance of motor winding with earthing (E).For rated voltage below 1KV, measured with a 500VDC Megger.For rated voltage above 1KV, measured with a 1000VDC Megger.In accordance with IEEE 43, clause 9.3, the following formula should be applied.Min IR Value (For Rotating Machine) =(Rated voltage (v) /1000) + 1As per IEEE 43 Standard 1974,2000IR Value in MIR (Min) = kV+1For most windings made before about 1970, all field windings, and others not described belowIR (Min) = 100 MFor most dc armature and ac windings built after about 1970 (form wound coils)IR (Min) = 5 MFor most machines with random -wound stator coils and form-wound coils rated below 1kVExample-1: For 11KV, Three Phase Motor.IR Value =11+1=12 M but as per IEEE43 It should be 100 MExample-2: For 415V,Three Phase MotorIR Value =0.415+1=1.41 M but as per IEEE43 It should be 5 M.As per IS 732 Min IR Value of Motor=(20XVoltage(p-p/(1000+2XKW))IR Value of Motor as per NETA ATS 2007. Section 7.15.1Motor Name Plate (V)Test VoltageMin IR Value250V500V DC25 M600V1000V DC100M1000V1000V DC100M2500V1000V DC500M5000V2500V DC1000M8000V2500V DC2000M15000V2500V DC5000M25000V5000V DC20000M34500V15000V DC100000MIR Value of Submersible Motor:IR Value of Submersible MotorMotor Out off Well (Without Cable)IR ValueNew Motor20 MA used motor which can be reinstalled10 MMotor Installed in Well (With Cable)New Motor2 MA used motor which can be reinstalled0.5 M(5) IR Value for Electrical cable and wiring:For insulation testing, we need to disconnect from panel or equipment and keep them isolated from power supply. The wiring and cables need to test for each other (phase to phase) with a ground (E) cable. The Insulated Power Cable Engineers Association (IPCEA) provides the formula to determine minimum insulation resistance values.R =IR Value in Ms per 1000 feet (305 meters) of cable.K =Insulation material constant.(Varnished Cambric=2460, Thermoplastic Polyethlene=50000,Composite Polyethylene=30000) D =Outside diameter of conductor insulation for single conductor wire and cable(D = d + 2c + 2b diameter of single conductor cable) d Diameter of conductor c Thickness of conductor insulation b Thickness of jacket insulationHV test on new XLPE cable (As per ETSA Standard)ApplicationTest VoltageMin IR ValueNew cables Sheath1KV DC100 MNew cables Insulation10KV DC1000 MAfter repairs Sheath1KV DC10 MAfter repairs Insulation5KV DC1000M11kV and 33kV Cables between Cores and Earth (As per ETSA Standard)ApplicationTest VoltageMin IR Value11KV New cables Sheath5KV DC1000 M11KV After repairs Sheath5KV DC100 M33KV no TFs connected5KV DC1000 M33KV with TFs connected.5KV DC15MIR Value Measurement (Conductors to conductor (Cross Insulation))The first conductor for which cross insulation is being measured shall be connected to Line terminal of the megger. The remaining conductors looped together (with the help of crocodile clips) i. e. Conductor 2 and onwards, are connected to Earth terminal of megger. Conductors at the other end are left free.Now rotate the handle of megger or press push button of megger. The reading of meter will show the cross Insulation between conductor 1 and rest of the conductors. Insulation reading shall be recorded.Now connect next conductor to Line terminal of the megger & connect the remaining conductors to earth terminal of the megger and take measurements.IR Value Measurement (Conductor to Earth Insulation)Connect conductor under test to the Line terminal of the megger.Connect earth terminal of the megger to the earth.Rotate the handle of megger or press push button of megger. The reading of meter will show the insulation resistance of the conductors. Insulation reading shall be recorded after applying the test voltage for about a minute till a steady reading is obtained.IR Value Measurements:If during periodical testing, insulation resistance of cable is found between 5 and 1 M /km at buried temperature, the subject cable should be programmed for replacement.If insulation resistance of the cable is found between 1000 and 100 K /km, at buried temperature, the subject cable should be replaced urgently within a year.If the insulation resistance of the cable is found less than 100 kilo ohm/km., the subject cable must be replaced immediately on emergency basis.(6) IR Value for Transmission / Distribution Line:Equipment. Megger SizeMin IR ValueS/S .Equipments5 KV5000MEHVLines.5 KV10MH.T. Lines.1 KV5MLT / Service Lines.0.5 KV5M(7) IR Value for Panel Bus:IR Value for Panel = 2 x KV rating of the panel.Example, for a 5 KV panel, the minimum insulation is 2 x 5 = 10 M.(8) IR Value for Substation Equipment:Generally meggering Values of Substation Equipments are..Typical IR Value of S/S EquipmentsEquipmentMegger SizeIR Value(Min)Circuit Breaker(Phase-Earth)5KV,10 KV1000 M(Phase-Phase)5KV,10 KV1000 MControl Circuit0.5KV50 MCT/PT(Pri-Earth)5KV,10 KV1000 M(Sec-Phase)5KV,10 KV50 MControl Circuit0.5KV50 MIsolator(Phase-Earth)5KV,10 KV1000 M(Phase-Phase)5KV,10 KV1000 MControl Circuit0.5KV50 ML.A(Phase-Earth)5KV,10 KV1000 MElectrical Motor(Phase-Earth)0.5KV50 MLT Switchgear(Phase-Earth)0.5KV100 MLT Transformer(Phase-Earth)0.5KV100 MIR Value of S/S Equipments As per DEP StandardEquipmentMeggeringIR Value at Commissioning Time (M)IR Value at Maintenance Time(M)SwitchgearHV Bus200 M100 MLV Bus20 M10 MLV wiring5 M0.5 MCable(min 100 Meter)HV & LV(10XKV) / KM(KV) / KMMotor & GeneratorPhase-Earth10(KV+1)2(KV+1)Transformer Oil immersedHV & LV75 M30 MTransformer Dry TypeHV100 M25 MLV10 M2 MFixed Equipments/ToolsPhase-Earth5K / Volt1K / VoltMovable EquipmentsPhase-Earth5 M1MDistribution EquipmentsPhase-Earth5 M1MCircuit BreakerMain Circuit2 M / KVControl Circuit5MRelayD.C Circuit-Earth40MLT Circuit-Earth50MLT-D.C Circuit40MLT-LT70M(9) IR Value for Domestic /Industrial Wiring:A low resistance between phase and neutral conductors, or from live conductors to earth, will result in a leakage current. This cause deterioration of the insulation, as well as involving a waste of energy which would increase the running costs of the installation.The resistance between Phase-Phase-Neutral-Earth must never be less than 0.5 M Ohms for the usual supply voltages.In addition to the leakage current due to insulation resistance, there is a further current leakage in the reactance of the insulation, because it acts as the dielectric of a capacitor. This current dissipates no energy and is not harmful, but we wish to measure the resistance of the insulation, so DC Voltage is used to prevent reactance from being included in the measurement.1 Phase Wiring:The IR test between Phase-Natural to earth must be carried out on the complete installation with the main switch off, with phase and neutral connected together, with lamps and other equipment disconnected, but with fuses in, circuit breakers closed and all circuit switches closed.Where two-way switching is wired, only one of the two stripper wires will be tested. To test the other, both two-way switches should be operated and the system retested. If desired, the installation can be tested as a whole, when a value of at least 0.5 M Ohms should be achieved.3 Phase Wiring:In the case of a very large installation where there are many earth paths in parallel, the reading would be expected to be lower. If this happens, the installation should be subdivided and retested, when each part must meet the minimum requirement.The IR tests must be carried out between Phase-Phase-Neutral-Earth with a minimum acceptable value for each test of 0.5 M Ohms.IR Testing for Low voltagecircuit voltageTest voltageIR Value(Min)Extra Low Voltage250V DC0.25MUp to 500 V except for above500 V DC0.5M500 V To 1KV1000 V DC1.0MMin IR Value = 50 M / No of Electrical outlet. (All Electrical Points with fitting & Plugs).Min IR Value = 100 M / No of Electrical outlet. (All Electrical Points without fitting & Plugs).Required Precautions:Electronic equipment like electronic fluorescent starter switches, touch switches, dimmer switches, power controllers, delay timers could be damaged by the application of the high test voltage should be disconnected.Capacitors and indicator or pilot lamps must be disconnected or an inaccurate test reading will result.Where any equipment is disconnected for testing purposes, it must be subjected to its own insulation test, using a voltage which is not likely to result in damage. The result must conform with that specified in the British Standard concerned, or be at least 0.5 M Ohms if there is no Standard.Cable testing is conducted to chart the gradual deterioration over the years, to do acceptance testing after installation, for verification of splices and joints, and for special repair testing.It is always appropriate to conduct the cable insulation resistance measurement test first, and if the data obtained looks good, then proceed with the DC overpotential test.After the DC overpotential test is completed, then perform the insulation resistance test again to assure that the cable has not been damaged during the DC overpotential test.The insulation resistance is measured using a Megohmmeter. This is a nondestructive method of determining the condition of the cable insulation to check contamination due to moisture, dirt, or carbonization.The insulation resistance measurement method does not give the measure of the total dielectric strength of cable insulation or weak spots in the cable. Generally, the following voltages can be used for the indicated cable voltage ratingThe following is the general procedure when using a megohmmeter for resistance measurement tests.Disconnect the cable to be tested from other equipment and circuits to ensure that it is not energized.Discharge all stored capacitance in the cable by grounding it before testing, as well as after completing tests. To discharge a cable, Connect a ground to the cable and leave it connected for at least four times the length of the test time. Do not touch the cable until it is fully discharged.Connect the line terminal of the instrument to the conductor to be tested.Ground all other conductors together to sheath and to ground. Connect these to the earth terminal of the test set.Similarly measure other insulation resistance values between one conductor and all other conductors connected, one conductor to the ground, and so on. The connections are shown in Figure given below.The guard terminal of the megohmmeter can be used to eliminate the effects of surface leakage across exposed insulation at the test end of the cable or both ends of the cable for leakage to the ground. The guard terminal is provided to bypass the current due to corona and surface leakage around the megohmmeter so that corona and surface leakage currents are not included in the test readings.Cable test connections for insulation resistance measurement.The insulation resistance measurements should be conducted at regular intervals and records kept for comparison purposes. Keep in mind that, for a valid comparison, the readings must be corrected to a base temperature, such as 20C. A continued downward trend is an indication of insulation deterioration even though the resistance values measured are above the minimum acceptable limit.Cable and conductor installations present a wide variety of conditions from the point of view of the resistance of the insulation. These conditions result from the many kinds of insulating materials used, the voltage rating or insulation thickness, and the length of the circuit involved in the measurement.Furthermore, such circuits usually extend over great distances and may be subjected to wide variations in temperature, which will affect the insulation resistance values obtained. The terminals of cables and conductors will also affect the test values unless they are clean and dry, or guarded.The Insulated Cable Engineers Association (ICEA) gives minimum values of insulation resistance in its specifications for various types of cables and conductors. These minimum values are for new, single-conductor wire and cable after being subjected to an AC high voltage test and based on a DC test potential of 500 V applied for 1 min at a temperature of 60F. These standard minimum insulation resistance (IR) values (for single conductor cable) are based on the following formula:IR = K log10(D/d)Where, IR is in meg-ohms per 1000 ft of cable, K is a constant for insulating material, D is the outside diameter of conductor insulation and d is the inside diameter of conductor.In the past, this test has been extensively used for the acceptance and maintenance of cables. Recent studies of cable failures indicate that the DC overpotential test may be causing more damage to some cable insulation, such as cross-link polyethylene, than the benefit obtained from such testing.It can indicate the relative condition of the insulation at voltages above or near operating levels. This test can be used for the identification of weakness in the cable insulation and can also be used to break down an incipient fault. Generally, it is not recommended that this test be used for the breakdown of incipient faults even though some test engineers use it for this purpose.Therefore, the incipient fault breakdown probability should be anticipated before and during the hi-pot test. The impending cable failure will usually be indicated by sudden changes in the leakage current, and before insulation is damaged, the test can be stopped.The test voltage values for DC hi-pot tests are based upon the final factory test voltage, which is determined by the type and thickness of insulation, the size of conductors, the construction of the cable, and applicable industry standards.The DC test values corresponding to AC factory proof test voltages specified by the industry standards are usually expressed in terms of the ratio of DC to AC voltage for each insulation system.This ratio is designated as K, which when multiplied by the acceptance test factor of 80% and maintenance factor of 60% yields the conversion factors to obtain the DC test voltages for hi-pot tests. These recommended test voltage conversion factors are shown in following Table .Conversion Factors for DC Hi-Pot TestsAlso, the IEEE standard 400.12007 lists the voltage values for conducting hi-pot acceptance and maintenance tests in the field for laminated shielded power cables, which are shown in Table 2.5.Field Test Voltages for Laminated Shielded Cables up to 69 kV System Voltage* Maintained for a duration of 15 min.Note: Voltages higher those listed, up to 80% of system BIL for installation and maintenance testing may be considered in consultation with the suppliers of cable and the accessories. When equipment, such as transformers, motors, etc., is connected to the cable circuit undergoing a test, voltages lower than recommended values may be used to comply with the limitations imposed by the connected equipment.Many factors should be considered in selecting the right voltage for existing cables that are in service. As a general rule, for existing cables, the highest values for maintenance should not exceed 60% of the final factory test voltage, and the minimum test value should be not less than the DC equivalent of the AC operating voltage. The hi-pot test can be conducted as a step-voltage test as discussed next.In this test, the voltage is raised in equal steps, and time is allowed between each step for the leakage current to become stable.The current is relatively high as a voltage is applied owing to capacitance charging current and dielectric absorption currents. As time passes, these transient currents become minimum with the steady-state current remaining, which is the actual leakage current and a very small amount of absorption current.At each step of voltage, the leakage current reading is taken before proceeding to the next step. Usually, it is recommended that at least eight equal steps of voltage be used and at least 14 min be allowed between each step.The leakage current versus voltage is then plotted as a curve. As long as this plotted curve is linear for each step, the insulation system is in good condition.At some value of step voltage, if the leakage current begins to increase noticeably, an increase in the slope of the curve will be noticed, as shown in Figure given below. The test should be stopped as soon as the increase of slope is noticed. If the test is continued beyond this test voltage, the leakage current will increase even more rapidly and immediate breakdown may occur in the cable insulation.Step-voltage hi-pot test current.Maximum leakage current allowable for new cables acceptance can be determined from the ICEA formula for minimum allowable insulation resistance discussed earlier. The formula for leakage current then can be written as follows:Where, IL is the conduction or leakage current, E is the test voltage impressed, K is the specific insulation resistance meg-ohms per 1000 ft at 60F, D is the diameter over insulation and d is the diameter over conductor.When the final test voltage of leakage current versus voltage test is reached, it can be left on for at least 5 min, and the leakage current versus time can be plotted for fixed intervals of time as the leakage current during this step reduces from an initial high value to a steady-state value.A curve for good cables will generally indicate a continuous decrease in leakage current with respect to time or steady-state value without any increase of current during the test. This curve is shown in following Figure.Leakage current versus time.The hi-pot test can be conducted as a go, no-go overpotential test. In this test, the voltage is gradually applied to the specified value. The rate of rising of the test voltage is maintained to provide a steady leakage current until the final test voltage is reached.Usually, 11.5 min is considered sufficient for reaching the final test voltage. The final test voltage can then be held for 5 min, and if there is no abrupt increase in current sufficient to trip the test set, the test has been successfully passed.This test does not provide a thorough analysis of cable condition but provides sufficient information as to whether the cable meets a specific high-voltage breakdown strength requirement.This type of test is usually performed after installation and repair, where only cable that can withstand strength verification without a breakdown is to be certified.Thanks for reading about cable insulation resistance test. I was asked to perform a test on the static grounding receptacles in a hanger on an army base. They are going to replace the receptacles and want me to test before and after to make sure they are at least equal to exitsing.I called the maintenance contractor that does the annual testing to get the procedure they use and the only info they would give me is that they use a megger and test to building steel. I have spent hours on the internet trying to come up with a standard testing procedure and have come up with zip about using a megger. I did a few with an ohm meter and came up with readings between 10k and 30K ohms and with the megger on 500V get 0 ohms.The test reports from the maintenance company all just say less thea 1K ohms. Any suggestions or advice would be greatly appreciated. Are you talking about a grounding system designed to connect to equipment to discharge static electricity - like possibly for working on solid state equipment that may be sensitive to static charges? If so megger is not what you want, higher the voltage applied the more easy it is to push current. You want something that will discharge static even at low voltage levels so I would think testing should involve application of low voltages. How to get desired test results for specifically what you are looking for I really don't know. I am not sure if it is for the working on electronics aspect or the static igniting fuel. Not much info out there on it. I am not sure if it is for the working on electronics aspect or the static igniting fuel. Not much info out there on it. If it is for prevention of static igniting fuel I would say check into fuel codes more so than electrical codes. Most of what may be related to fuel in NEC is going to be Art 500 - 516 but those don't really apply much to discharge of static as they do to prevention of ignition by electrical equipment. Checking to building steel or any other conductive material is all that is required. All the static lines do is insure that no spark occurs when the fueling nozzle contacts the aircraft. Checking to building steel or any other conductive material is all that is required.All the static lines do is insure that no spark occurs when the fueling nozzle contacts the aircraft. Is fueling normally done inside the hangers? My first guess is it is never done there. Fuel may be present at times in a major repair area but not a storage hanger and even if general maintenance is done in the storage hanger. If I just need to check to building steel do I just use an ohm meter or a megger. If a megger what voltage? If I just need to check to building steel do I just use an ohm meter or a megger. If a megger what voltage? I think you need a meter that is accurate at very low resistance. The high voltage of a megger is not what you need as it is intended to measure very high resistances more accurately by applying more test voltage that a regular multipurpose meter just doesn't do. NFPA 77 for Static Control specifies that the bonding paths have a resistance of 10 ohms of less. I think that is just a number they picked for testing purposes. The IEEE Green Book says that a resistance of 1,000,000 or less will prevent static build-up. NFPA 77 for Static Control specifies that the bonding paths have a resistance of 10 ohms of less. I think that is just a number they picked for testing purposes. The IEEE Green Book says that a resistance of 1,000,000 or less will prevent static build-up. If that is the standard then fairly inexpensive multimeter should be accurate enough. NFPA 77 is the Recommended Practice for Static electricity. NFPA 77 specifies a maximum resistance of 1 megohm (1,000,000 ohms) to prevent static sparks for bonding and grounding. In practice, higher resistances, up to 100 megohms may suffice. It only mentions 10 ohms as a guideline where metallic conductors are used to indicate if conductors and connections may be deteriorating. A 500 volt megohm meter is the preferred instrument for electrostatic resistance measurements since it will produce real world resistance measurements as applicable to the hazard. Below 500 volts, there is generally no hazard of an incendive discharge from static electricity. Hello, I have a question regarding cable insulation rating. To provide you with a background, we are tapping the iso-phase bus duct to power up an Auxiliary Bank for a steam turbine unit. The nominal voltage rating of this bus is 13.8kV; generator output is 13.8kV, and GSU xfmr is rated 13.8kV-230kV. The BOP design and construction company who built this unit installed medium voltage cable rated at 25kV, 133% insulation when tapping the iso-phase to the aux bank high side. Unfortunately, they installed a conduit that just the minimum size of what was needed, and we have come to a point where we need to up-size the cable. My proposal is the following: instead of going with the same insulated-rated cable and having to install new conduit, downsize to 15kV, 133% insulated cable. This way, the overall insulation thickness of the cable is reduced and we can up the conductor size while still remaining within NEC fill requirements. In addition, this cable is readily stocked by Okonite (a cable mfr). Compared to this, 25kV rated cable (100% or 133% insulated cable) requires minimum order of 3000 feet and a 12 week lead time. A plant electrician says we cannot do this due to the swings from the generator and grid-side. But I have dug up metering data from the past 2+ years that shows the max voltage occurrence that has ever happened on the iso-phase bus to be 14.65kV. In addition, I believe that the 133% insulation level will also provide plenty of added protection in case of potential faults, future voltage swings, etc. Am I missing anything here? Is there a reason why the BOP contractor decided to go with 25kV @ 133% insulated cable? Is there any counter argument anyone can provide on why I cannot use 15kV @ 133% insulated cable for this 13.8kV system? My suspicion of why this cable (i.e. 25kV @ 133%) was installed in the first place is because another unit built by the same contractor at the same has its' iso-phase bus rating of 18kV. The BOP contractor had to buy 25kV rated cable in bulk (cable manufacturers require minimum orders of 3000' as stated above) for this unit so they decided to use it for this other 13.8kV system instead of wasting the 25kV bulk-ordered cable. I haven't been able to confirm this with the BOP contractor since they built these units before my time at the plant.I appreciate any help you guys can provide. Please let me know if you have any questions. Seems like a reasonable approach Seems like a reasonable approach Thank you for your reply! Yeah,