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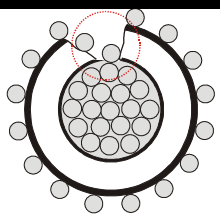
Cable Fault Profiles and Troubleshooting Guide

SHORTED CONDUCTOR (Bolted Fault)

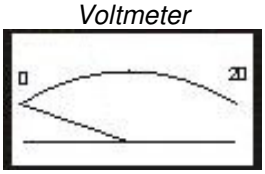


Circuit Equivalent

Shorted conductor or bolted fault occurs when the insulation burns to a state where the cable conductor and cable neutral or sheath is in contact with one another. Insulation resistance is zero to only a few ohms. There is no gap value and therefore this fault will not arc or “thump”.

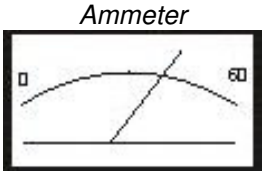
Surge Generator

Voltmeter



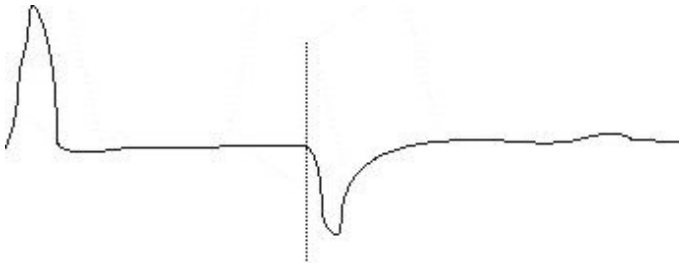
During a proof test the kilo-voltmeter will read zero and will show no movement.

Ammeter



During a proof test the ammeter will continue to rise as the output of the proof tester is raised.

DART Analyzer Data



Shorted conductor or bolted faults can be localized by using Time Domain Reflectometry (TDR). The reflected pulse will be negative.

Since there is no gap value associated with a shorted conductor the fault will not arc or “thump”. Acoustic pinpointing will not be an option. A surge generator (thumper) can still be used for pinpointing if an electromagnetic impulse detector is used along with the surge generator.

Surge the cable with the surge generator. Track the surge pulse using an electromagnetic detector such as the Megger Pinpointer, MPP 1000. You will detect strong signals up to the true fault location. Since the entire surge energy is lost at the fault, weak or no signal will be detected beyond the fault.

Megger

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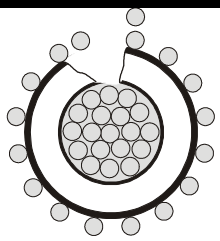
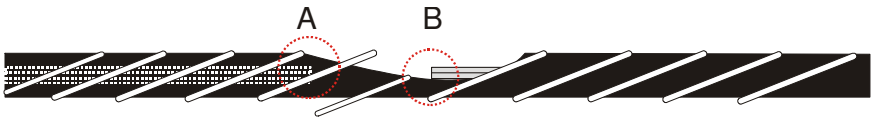
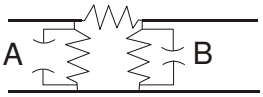
OPEN CONDUCTOR (Blow-out)





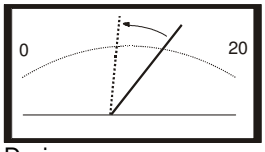


Circuit Equivalent

Open conductor or blow-out occurs due to a high fault current, a dig-in or a failed splice. An insulation resistance test may indicate a high resistance value if the fault and ground is dry. If the ground is moist the resistance measurement may show a moderate to low resistance value at the fault. If the phase conductor or concentric burns back the gap distance may be excessive and may not arc or "thump", refer to fault position 'A'. Testing from the other end of the cable may render better results as shown in position 'B'.

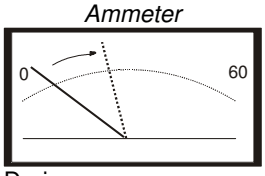
Surge Generator

Voltmeter



During a surge discharge (thump) the voltmeter will give a weak drop and will never approach zero volts (Fault A). Fault B will give a strong drop in the voltmeter, practically reaching zero.

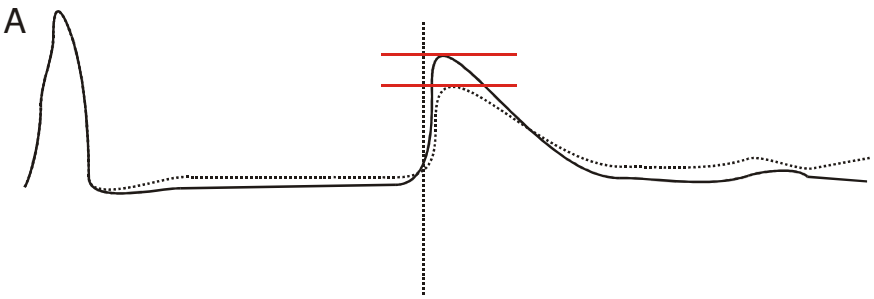
Ammeter



During a surge discharge (thump) the ammeter will give a weak kick forward (Fault A). Fault B will give a strong kick forward.

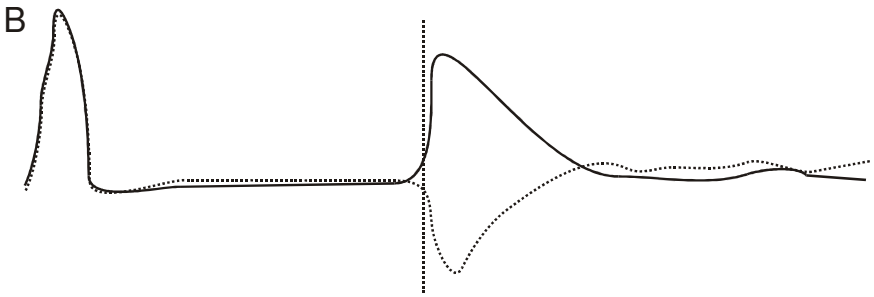
DART Analyzer Data

A



An open conductor or blow-out will appear as a positive reflection on a Time Domain Reflectometer (TDR) as shown by the solid TDR signature. If the conductor or concentric is burned back and the gap value is excessive, the fault may not arc (thump). This will result in little or no change in the TDR signature when the Arc Reflection test is performed. The solid signature shown above represents the before surge TDR signature; the dotted line represents the after surge signature.

B



As stated previously, an open conductor or blow-out will appear as a positive reflection on a TDR. If the gap distance between the conductor and concentric has not burned back the fault image will invert or reflect negative when the Arc Reflection test is performed as seen in the dotted TDR trace. This also indicates good arc or 'thump' condition.

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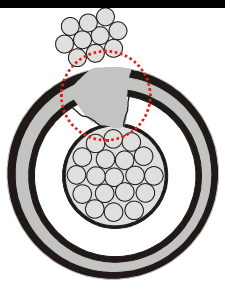
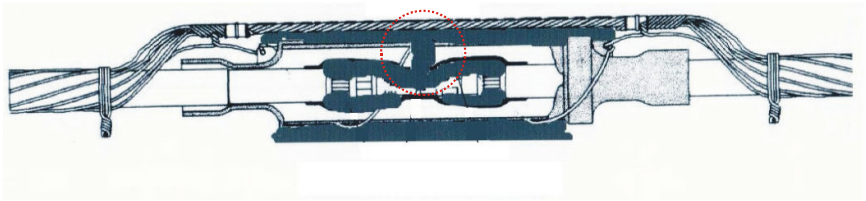
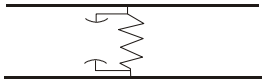
SPLICE FAILURE





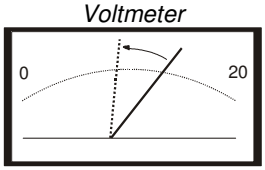


Circuit Equivalent

A failed splice can be a difficult fault to identify and locate. Since the physical distance between the phase conductor and concentric is increased, the gap distance is typically excessive. This creates a fault that may not arc or 'thump'.

Surge Generator

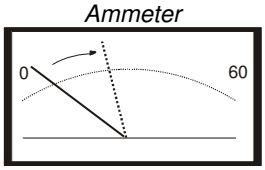
Voltmeter



During a surge discharge (thump) the voltmeter will give a weak drop and will never approach zero volts. The fault may not arc or break-down on every discharge cycle.

During a proof test the cable may hold voltage for a brief period before flashing over.

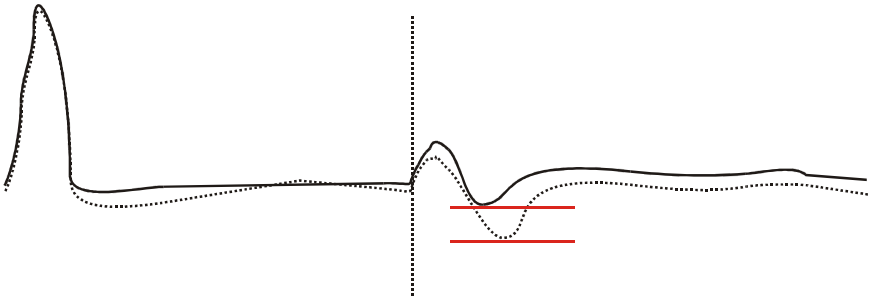
Ammeter



During a surge discharge (thump) the ammeter will give a weak kick forward.

Burn current may be necessary to reduce the fault resistance and gap distance.

DART Analyzer Data

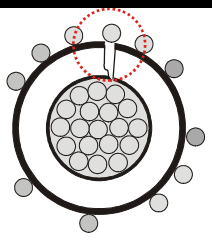


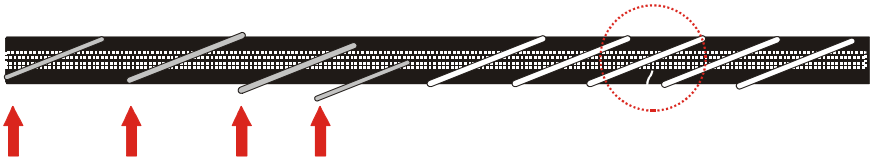
A splice failure is very similar to an open conductor (blow-out) in the sense that the resistance and gap value at the fault will typically be very high. The excessive gap value may make it difficult to arc or 'thump' the cable. The fault may not arc on every discharge cycle. Applying burn down current may be required to improve break-down performance.

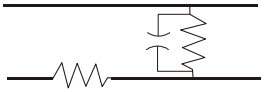
The time domain reflectometer pattern for a splice is a small positive reflection that is immediately followed by a small negative reflection. Refer to the solid signature shown above. If water is present within the splice the negative reflection will typically be more pronounced. When the Arc Reflection test is performed the signature of the splice may change slightly, becoming more pronounced on the negative as shown in the dotted signature above. This indicates that during the surge or 'thump' the resistance of the splice is becoming lower and that a 'thump' is occurring. If the gap between the conductor and concentric is too excessive the Arc Reflection test will show no change in the TDR signature. This indicates that no 'thump' is occurring and burn-down may be required.

Cable Fault Profiles and Troubleshooting Guide

CORRODED OR OPEN CONCENTRIC





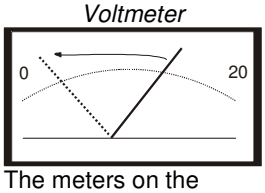


Circuit Equivalent

WARNING: Corroded or open concentric will present several issues during a fault locate. The concentric is designed to carry fault current. If the integrity of the concentric is jeopardized due to open strands or high levels of corrosion the concentric may no longer provide the lowest resistance path back to the surge generator. In this case the fault current will follow the least resistant path which may be fence posts, phone shields, cable TV shields, gas tracer wires, other utility cables or the damp earth itself. Humans or animals touching the fence post, phone, TV, waterline, etc. can be injured or killed. Use of a surge generator (thumper) should be approached with great caution. Surge at the lowest possible voltage and for the shortest amount of time.

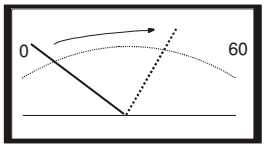
Surge Generator

Voltmeter

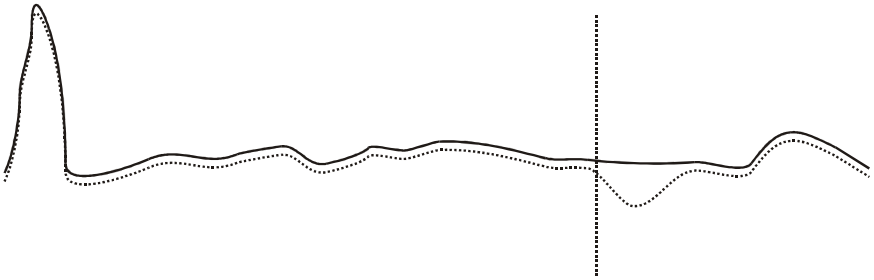


The meters on the surge generator (thumper) will provide little to no indication of concentric corrosion. If an arcing fault exists on the cable the meters will simply show a sharp drop in voltage and a sharp kick in current when the cable is surged (thumped).

Ammeter



DART Analyzer Data



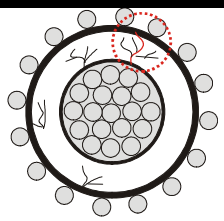
The time domain reflectometer signature can help identify possible corroded concentric issues prior to using a surge generator or 'thumper'. Small random reflections, typically positive in orientation, may be observed indicating areas of high metallic resistance. It may be difficult to detect the end of the cable due to excessive attenuation of the TDR's transmitted pulse.

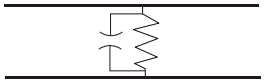
When the Arc Reflection test is performed a negative reflection will be captured at the location of the arc or 'thump'. Safety precautions should be taken during the pinpointing stage. Corroded concentric presents step potential hazards.

Megger

Cable Fault Profiles and Troubleshooting Guide

ELECTRICAL TREE (Pin hole)



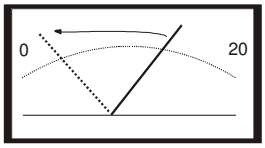


Circuit Equivalent

Electric trees or pin holes are the most common fault found in underground electrical power cable. The fault starts through a process of water ingress or small defects in the dielectric. Through age these defects begin to grow taking on the pattern of tree branches. Eventually one of these branches will breach the cable insulation and become a fault.

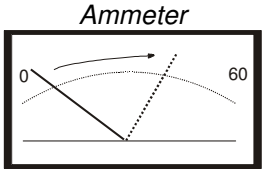
Surge Generator

Voltmeter



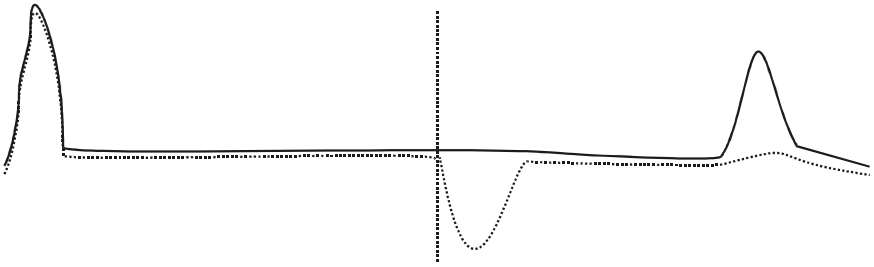
After discharge from the surge generator (thumper) the voltmeter will give a strong kick back, nearly reaching zero volts.

Ammeter



After discharge from the surge generator (thumper) the ammeter will give a strong kick forward.

DART Analyzer Data



The time domain reflectometer signature will first show the end of the cable under test. The cable end will be seen as a positive reflection indicating an open. Refer to the signature shown with a solid line. After the Arc Reflection test a negative reflection will be captured from the point of the fault. The fault will be shown as a negative reflection indicating the short circuit created by the arc (thump).

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