



Cable Fault Location Guide



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POWER

About This Guide

Cable fault location finds the point where a power cable has failed so it can be dug up and repaired in one excavation. The fault is diagnosed, prelocated to a distance along the cable with a reflectometer, then pinpointed on the ground with a surge generator and a receiver. This guide covers the methods, safety and how to judge a result.

What Fault Location Is

A sequence of tests on a failed, isolated cable: diagnose the fault type and resistance, prelocate it to a distance along the cable, then pinpoint it on the ground so one excavation reaches it.

When It Is Used

After a cable trips in service, when a cable fails its commissioning or maintenance test, and when a sheath test shows the outer sheath has been damaged.

Why It Matters

Every excavation in the wrong place costs time, money and outage minutes. A methodical sequence reaches the fault in one dig, and limits the high voltage stress applied to a cable that will go back into service.

Guide at a Glance

Sequence

Diagnose, prelocate, condition if needed, pinpoint, repair, retest.

Methods

TDR (pulse echo), arc reflection, impulse current, voltage decay, bridge, acoustic and electromagnetic pinpointing.

Key Threshold

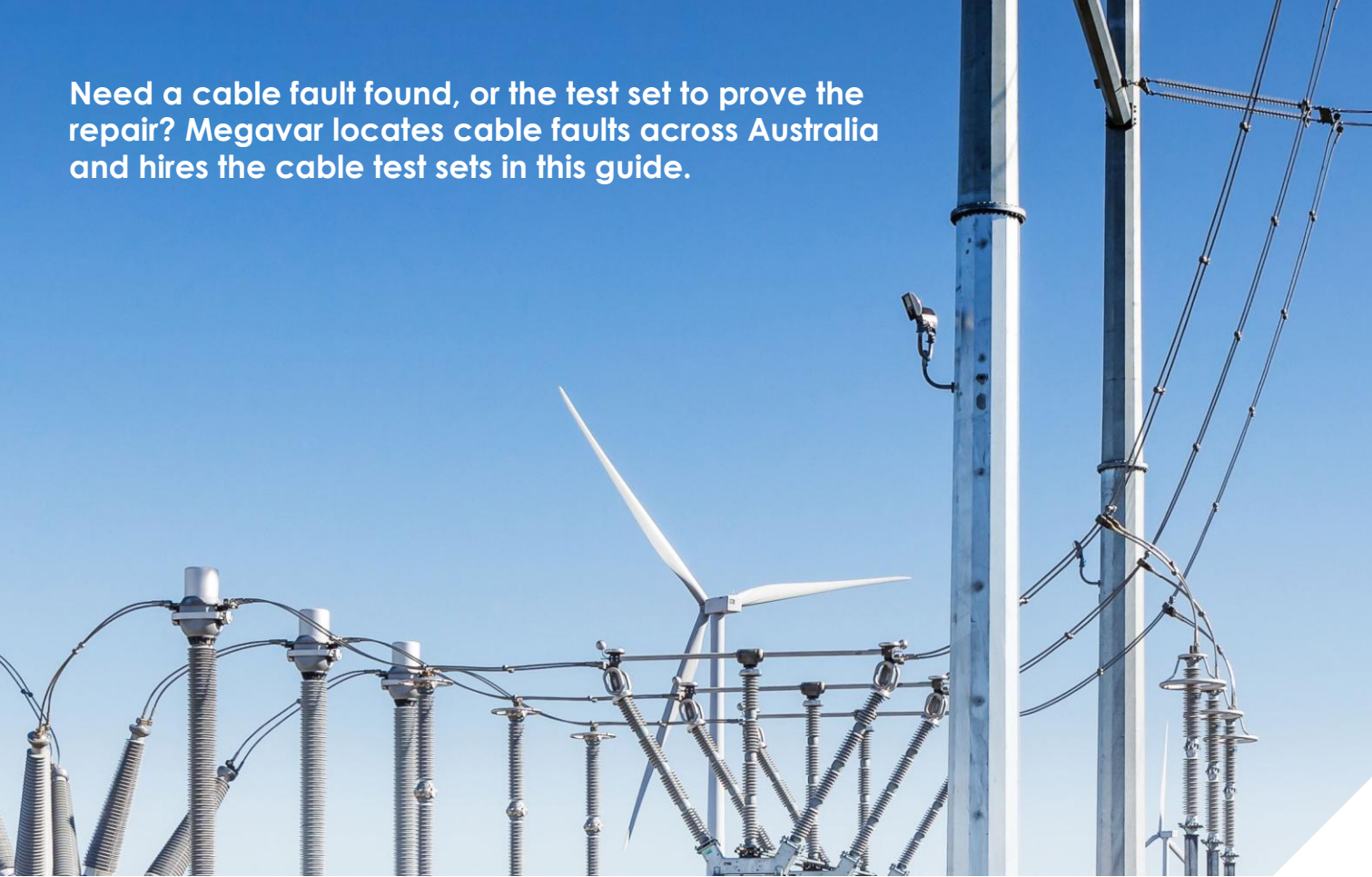
As a rule of thumb, below about 300 Ω a low voltage TDR sees the fault; above it a high voltage method is needed (Megger, 2012).

Standards

IEEE 400-2023 for field testing and thumper practice (cl 5.5); fault locating itself is IEEE 1234.

After Repair

Retest the cable before it is re-energised (IEEE 400-2023, cl 5.3.3).



Need a cable fault found, or the test set to prove the repair? Megavar locates cable faults across Australia and hires the cable test sets in this guide.

Why Locate a Cable Fault Methodically?

Cable Fault Location in Four Numbers

300 Ω

Between low and high resistance faults (Megger, 2012)

1,500 J

Surge energy of a portable surge generator (Megger, 2012)

5 to 10 min

To make a TDR measurement (IEEE 400-2023, cl 6.5.2)

0.5%

Best prelocation accuracy, long cables (BAUR, 2020)

Why a Method Matters

One Dig, Not Five

A cable is buried along a route that may run for kilometres. Prelocation narrows the search to a short stretch; pinpointing narrows it to the spot. Each step skipped means more excavation and a longer outage.

Faults Vary Widely

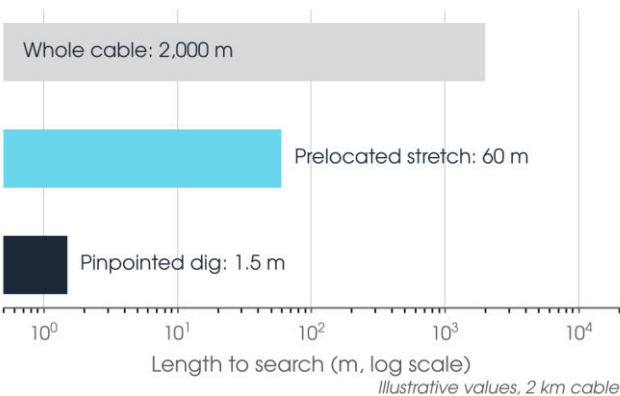
Megger describes shunt faults from near zero ohms to many megohms, breaks, moisture ingress, sheath faults and flashing faults that only break down above a threshold voltage. The fault type decides the method.

The Cable Goes Back Into Service

IEEE 400-2023 (cl 5.5) warns that thumping at high voltage can affect the insulation, and asks for the minimum voltage that breaks the fault down. A method limits that stress.

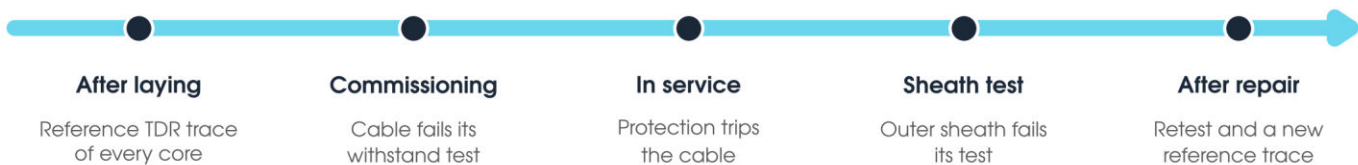
From the Whole Route to the Spot

Length searched at each stage



Prelocation turns a route into a short stretch to search; pinpointing turns the stretch into one excavation.

When to Locate



Where Is It Used?

Fault Types and the Method That Suits Each

Fault type	What it looks like	Prelocation method
Low resistance shunt fault	Core to core or core to screen, below about 300 Ω (Megger, 2012)	Low voltage TDR: a negative going reflection
High resistance shunt fault	Above about 300 Ω ; the TDR sees no clear reflection	Arc reflection or impulse current with a surge generator
Flashing or intermittent fault	Breaks down only above a threshold voltage, then reseals	Arc reflection, impulse current or voltage decay; condition if unstable
Break (series fault)	Conductor open or partly open	TDR: a positive going reflection
Moisture ingress	Low insulation resistance over a wet stretch, often all cores	TDR shows a change of impedance over the wet section
Sheath (serving) fault	Outer sheath to earth fails its sheath test; core insulation is tested separately	Bridge measurement, then DC or audio frequency pinpointing

Choosing the Method

Measure the Fault First

A multimeter or insulation tester gives the fault resistance between each core, and between each core and the screen. Megger notes an insulation tester may lack resolution below about 5 k Ω ; use the ohms range.

The Standards

IEEE 400-2023 covers field testing of shielded cables rated 5 kV and above, and refers fault locating to IEEE 1234 (cl 5.1). Its thumper caution (cl 5.5) and safety clause (Clause 4) are still relevant.

The Asset Owner's Rules

Set who may apply high voltage to their cable, the permit, and the retest required before return to service.

Our Recommendation

Diagnose, TDR every core, use the lowest voltage method that shows the fault, and pinpoint with acoustic and electromagnetic signals together.

Low Voltage or High Voltage

Low Voltage Methods

A TDR sends a low voltage pulse and needs no high voltage. It suits low resistance faults and breaks, and gives the reference trace for every later method.

High Voltage Methods

A surge generator discharges a capacitor into the cable to make the fault flash over. The arc is briefly a short circuit, which the TDR or a transient recorder can see.

A Passed Test Proves Little

Megger warns that a 5 kV insulation test will not find a fault that needs 8 kV to break down. A healthy insulation reading does not mean a healthy cable.

Good to Know

Take a TDR trace of every new cable after it is laid. BAUR notes that many standards recommend this fingerprint, and it makes every later fault easier to read.

How Does It Work?

Reflections Along the Cable

Pulse Echo (TDR)

A low voltage pulse travels along the cable and part of it reflects wherever the impedance changes. The reflection coefficient runs from +1 for an open circuit to -1 for a short circuit (IEEE 400-2023, cl 6.5.1).

Distance From Time

The pulse goes to the change and back, so the distance is $L = v \times t / 2$, where v is the propagation velocity of that cable (Megger, 2012).

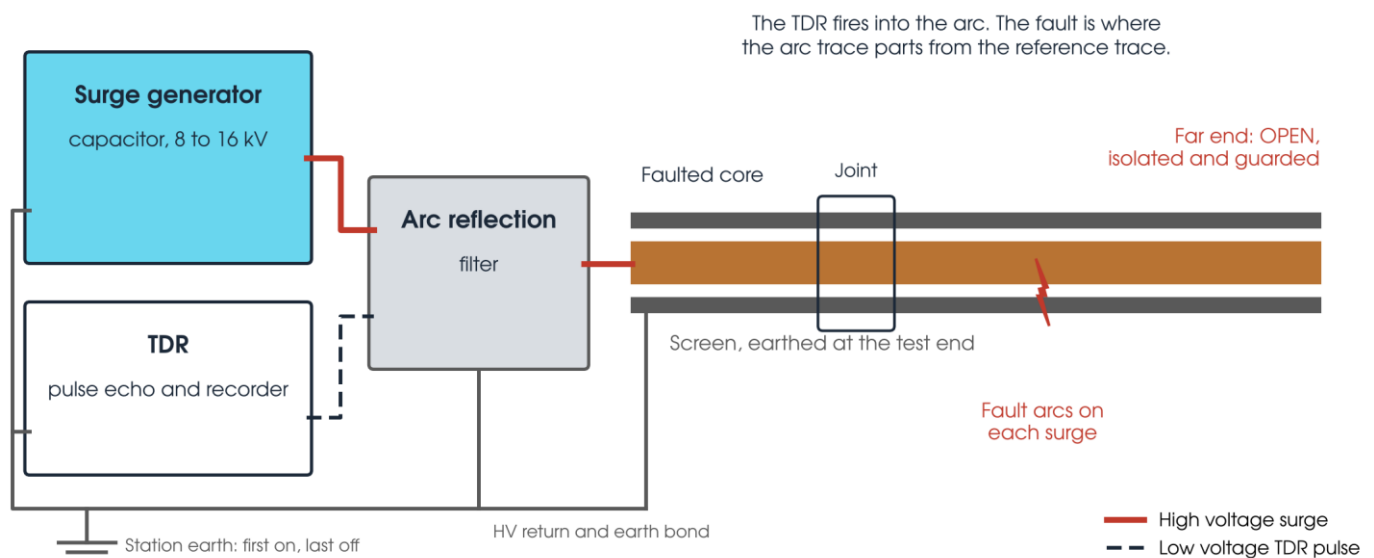
Arc Reflection

A reference trace is taken at low voltage, then a surge makes the fault arc and the TDR fires into the arc. The fault is where the two traces part (Megger, 2012).

Impulse Current and Voltage Decay

The surge, or a DC source, breaks the fault down and a coupler records the transient travelling between fault and source. Its period gives the distance.

Arc Reflection Connection



The surge generator, arc reflection filter and TDR connect to the faulted core at one end; the screen is earthed and the far end is open and guarded.

Pinpointing on the Ground

Acoustic

Each surge makes a bang at the fault that a ground microphone picks up. The sound is loudest directly over the fault.

Electromagnetic

The surge current also radiates a magnetic pulse that arrives almost instantly. The receiver times the sound against it.

Time Difference

The delay between the magnetic pulse and the sound is shortest directly over the fault (Megger, 2012). The change in delay as the operator moves gives direction, not just loudness.

Good to Know

Use the lowest surge voltage that still flashes the fault over; on a two range generator such as the Megger MIG16-2 the lower range gives full energy at the lower voltage (Megger, 2012). IEEE 400-2023 (cl 5.5) also asks for the minimum voltage, to limit stress on the insulation.

How Do I Set Up Safely?

Permits, Isolation and Earthing

1 Permit at Both Ends

Work only on a de-energised, isolated cable (IEEE 400-2023, Clause 4), under the asset owner's safety rules with the permit covering both ends.

2 Remote End Cleared and Guarded

Barricade the far end and keep voice contact with it. The cable is at high voltage there too (IEEE 400-2023, Clause 4).

3 Disconnect Connected Plant

Remove VTs, surge arresters and other items that cannot take the surge, and consider the voltage across any open switch to live plant (IEEE 400-2023, cl 5.4.3).

4 Earth Before Touching

Prove dead and apply earths before each connection change. A cable holds charge, and dielectric absorption rebuilds it after a discharge (IEEE 400-2023, Clause 4).

Who Should Do It

Competent HV testing personnel authorised under the asset owner's rules. AS 2067 cl 2.1.1 requires competent personnel in substations; between installations the asset owner's rules govern.

Fault Location Hazards

Stored Energy

A portable surge generator such as the Megger MIG16-2 stores 1,500 J at 8 or 16 kV (Megger, 2012). Use discharge and earthing sticks rated for the voltage and the cable capacitance.

The Route Is Live Ground

While surging, the faulted core and its terminations rise to the surge voltage on every pulse. Keep people and machines clear of open pits, exposed terminations and joints.

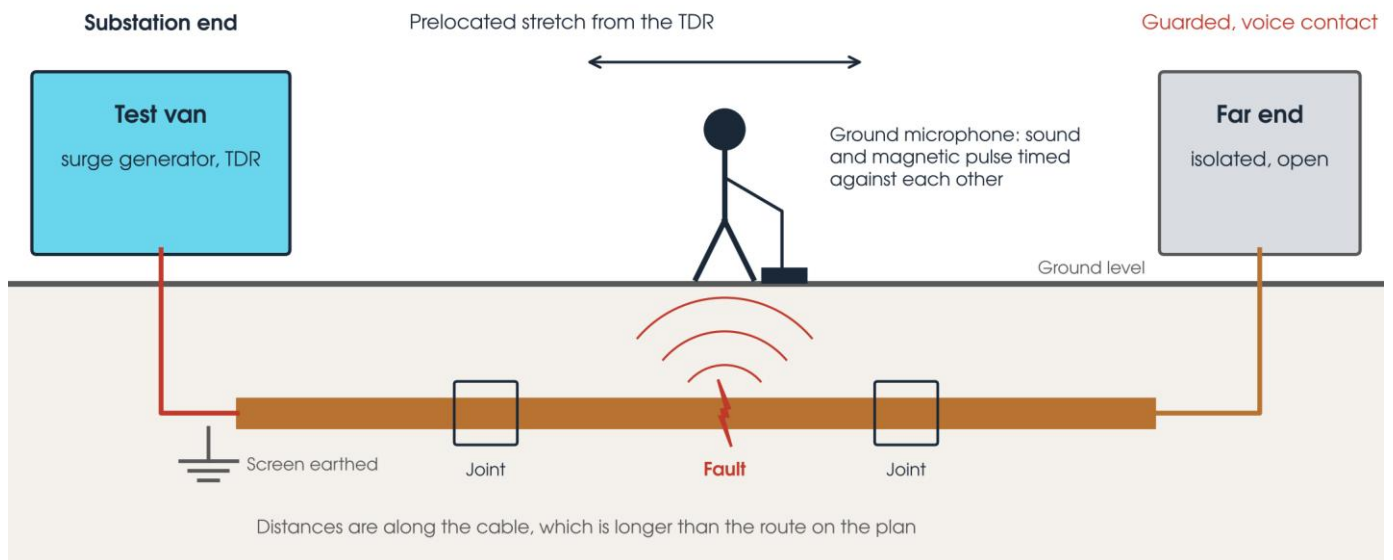
Over-Conditioning

Burning a fault too long can make a dead short to earth that is very hard to pinpoint acoustically (Megger, 2012).

Other Services Near the Dig

Locate and mark other services along the route before any excavation.

Set-Up Along the Cable Route



Test set at one end with the screen earthed, far end isolated, open and guarded, and the operator walking the route with a pinpointing receiver.

Important

This guide describes general practice for competent HV testing personnel. It is not a work procedure. Work under the asset owner's safety rules, the access permit and a site-specific safe work method statement. Manufacturer and asset owner criteria take precedence over the general guidance here.

How Do I Make the Measurement?

Seven Steps



Steps 1 to 4

1 Isolate and Earth

Isolate and earth both ends, disconnect connected plant and guard the far end.

2 Identify the Faulted Cable

Confirm which cable and which core has failed, by continuity or by comparing TDR traces of each core (Megger, 2012).

3 Diagnose the Fault

Measure resistance core to core and core to screen. Where a fault only shows at higher voltage, raise each core in turn, within the voltage limit the asset owner sets for that cable, and note the breakdown voltage.

4 Prelocate

Low resistance faults and breaks with the TDR; high resistance and flashing faults with arc reflection, impulse current or voltage decay.

Steps 5 to 7

5 Condition If Needed

If the fault will not break down steadily, a burn function can lower its resistance. Return to arc reflection once the discharge is stable (Megger, 2012).

6 Pinpoint

Walk the prelocated stretch with the surge running at the lowest voltage that flashes the fault over. Mark the spot where sound and magnetic pulse are closest in time.

7 Repair and Retest

After the repair, retest the cable before it is re-energised (IEEE 400-2023, cl 5.3.3), and take a new TDR reference trace.

Good to Know

Prelocate from both ends on a long cable. BAUR reports prelocation accuracies of up to 0.5% of cable length, depending on the method; measuring from both ends improves accuracy.

Common Mistakes

Skipping the Diagnosis

The wrong method is chosen and the fault never shows on the trace.

Velocity Not Set

Every distance on the TDR scales with v ; a wrong value moves the fault.

Cable Length Read as Route Length

Snaking, slack and joints make the cable longer than the route on the plan.

First Impulse Pulse Measured

It includes the ionisation delay; Megger advises using the second or third pulse.

More Common Mistakes

Surging at Maximum Voltage

Stresses the healthy insulation for no benefit (IEEE 400-2023, cl 5.5).

Burning Too Long

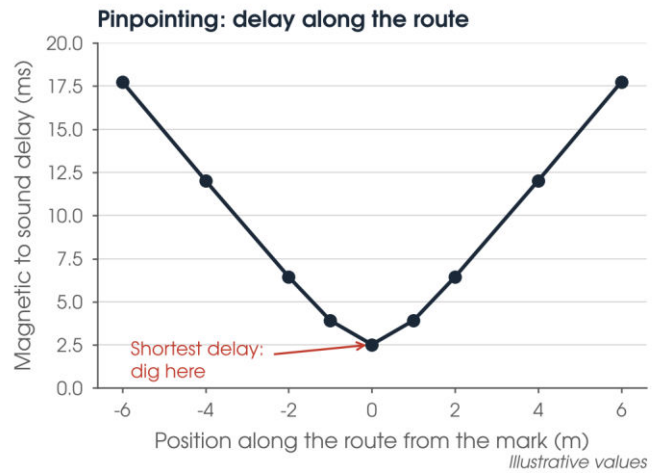
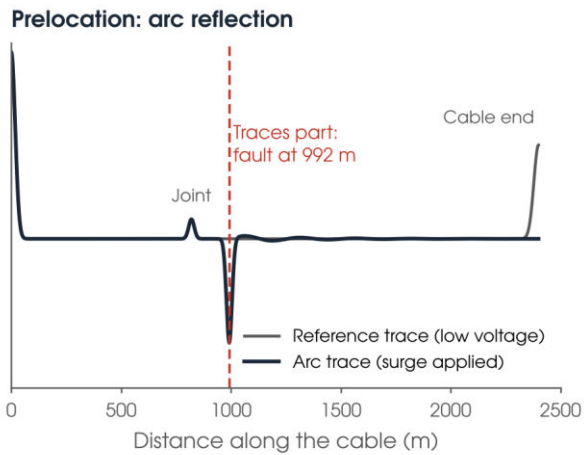
A dead short to earth is silent to the ground microphone.

No Retest After Repair

A second weak spot can fail on re-energisation.

How Do I Read the Result?

Arc Reflection Trace and Pinpointing Readings



The arc trace parts from the reference trace at the fault, beyond the joint. On the ground, the delay between magnetic pulse and sound reaches its minimum over the fault.

Comparing the Result

Against the Good Cores

A healthy core on the same cable gives the same joints and end at the same distances. The difference is the fault.

Against the Reference Trace

The fingerprint taken after laying shows every joint, so a new reflection stands out.

Against the Route Records

Joint positions and cable lengths from the as-built records turn a distance into a place on the ground.

Against the Calibration

Check the velocity on a known length or a known joint before trusting the distance.

What a Trace Can Tell You

Negative Reflection

A drop in impedance: a low resistance shunt fault or a short (IEEE 400-2023, cl 6.5.1).

Positive Reflection

A rise in impedance: an open circuit or a break in the conductor.

Reflection at a Joint

Joints show on every trace; a fault at a joint shows as a change against the good cores.

No Clear Reflection

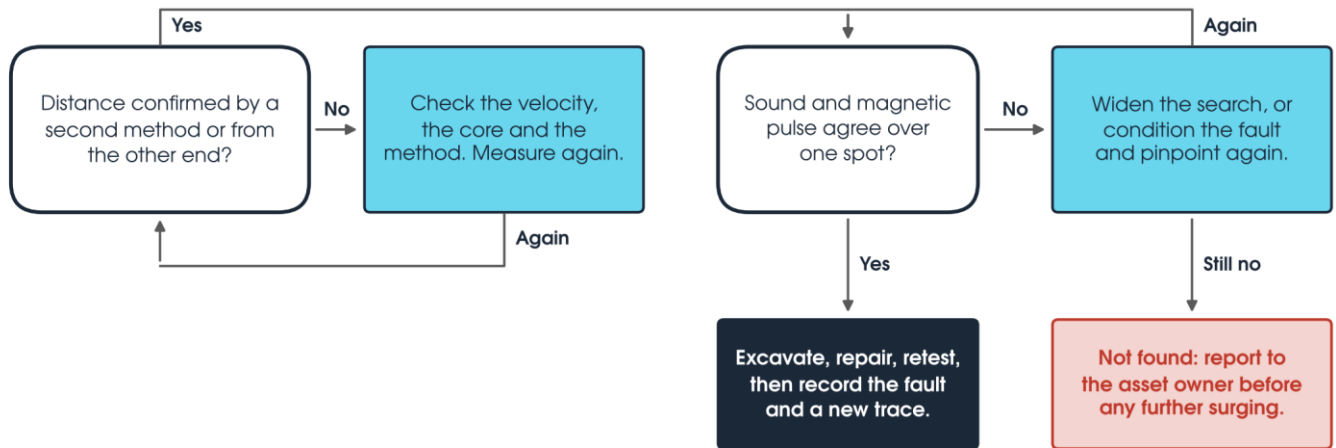
The fault is high resistance: check the connections, range and velocity first; if there is still nothing, it is likely a high resistance fault for a high voltage method.

Gradual Change Over a Section

Water in the cable over a length, often reaching to the next joint (Megger, 2012).

Is My Result OK?

Decision Path



Calculating the Distance

Set the velocity from a length you know before reading any distance. The end of a healthy core is the usual reference:

$$v = 2 \times L(\text{known}) / t(\text{end}) \quad L(\text{fault}) = v \times t(\text{fault}) / 2$$

t is the time to the reflection on the TDR.

Worked Example

A core of known length 2,400 m reflects its end at 30.0 μs , so $v = 2 \times 2,400 / 30.0 = 160 \text{ m}/\mu\text{s}$. The fault reflects at 12.4 μs : $160 \times 12.4 / 2 = 992 \text{ m}$ along the cable. Illustrative values.

What to Report

Cable and Fault

Cable, route, length, core and the fault type and resistance found at diagnosis.

Prelocation

Method, velocity used, distance from each end, and the traces saved.

Pinpoint

Surge voltage used, the location marked against fixed references and joint positions.

Repair and Retest

The test after repair, its voltage and result (IEEE 400-2023, cl 5.6), and the new reference trace.

What About Sheath Faults and Long Cables?

Sheath Faults

Why They Matter

A damaged outer sheath lets water reach the screen and corrode it, and can lead to a core fault later. BAUR notes sheath fault location is gaining importance for this reason.

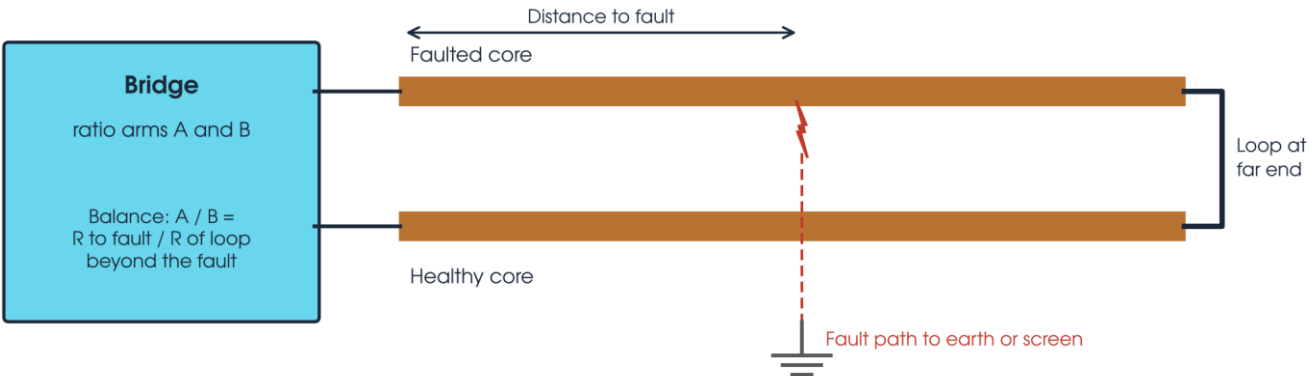
Finding One

A DC sheath test between the metallic screen and earth, at the voltage the cable maker or asset owner sets, typically 3 to 10 kV to IEC 60229, shows the damage. Megger notes sheath to earth faults pinpoint very reliably with DC or audio frequency methods.

Bridge Measurement

A Murray bridge loops the faulted conductor to a healthy one at the far end and compares resistances. It needs a healthy core and does not lose accuracy with distance (BAUR, 2020).

Murray Bridge Loop



Long Cables

Attenuation

TDR sensitivity falls with length and with the number of joints. A high resistance fault cannot be seen by low voltage TDR; arc reflection, or burning it down, makes it visible (BAUR, 2020).

Measure From Both Ends

BAUR reports accuracies of up to 0.5% of length, depending on the method, and Murray bridge location of faults on submarine cables hundreds of kilometres long.

Good to Know

Have the method ready before the fault. On long transmission cables BAUR recommends keeping fault location equipment at the cable ends so a fault can be located at once.

Recommended Solutions

Instrument	Capability	Best used for
Megger MIT1020 10 kV	Insulation resistance to 10 kV	Fault diagnosis, core and sheath tests
Megger MIT520 5 kV	Insulation resistance to 5 kV	Fault diagnosis and sheath tests on distribution cable
HVA 60 kV VLF test set	VLF withstand to 60 kV peak (42 kV RMS)	Proving a suspect cable and retesting after repair
HVA 28 kV VLF with tan delta	VLF withstand and tan delta	Retest and condition check of the repaired cable

Fault location itself is a Megavar testing service. The test sets are available calibrated, with leads, from Hobart, Launceston, Adelaide and Newcastle: [cable testing equipment hire](#).

Frequently Asked Questions

Common Questions

How can I locate a cable fault?

Diagnose the fault resistance, prelocate it with a TDR or a high voltage method, then pinpoint it on the ground with a surge generator and an acoustic and magnetic receiver.

How does a cable fault locator work?

It times reflections of a pulse sent along the cable, or of the transient made when a surge breaks the fault down. Distance is velocity times time, halved.

How to find a fault in a cable?

Isolate and earth it, find which core has failed, prelocate the fault to a distance, then walk the route with a receiver while the cable is surged.

What is a cable fault locator TDR?

A time domain reflectometer: it sends a low voltage pulse and shows reflections at every change of impedance along the cable.

Standards and References

IEEE Std 400-2023, Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems Rated 5 kV and Above.

IEEE Std 1234, Guide for Fault-Locating Techniques on Shielded Power Cable Systems, as referred to by IEEE 400-2023, cl 5.1.

AS 2067:2016, Substations and high voltage installations exceeding 1 kV a.c., cl 2.1.1.

Megger, A Guide to Safe and Efficient Power Cable Fault Location, 2012.

BAUR (Dunker, R.), Fault Location on Long Power Cables, np, Year 59, Issue 9, 2020, from p. 24.

High Voltage Inc., Introduction to Cable Fault Location, 2021.

More Questions

How can I locate a fault in an underground cable?

The same sequence. The cable records turn the prelocated distance into a place on the ground, and pinpointing finds the spot to excavate.

Can a thumper damage a cable?

Thumping at high voltage can affect the insulation, so IEEE 400-2023 (cl 5.5) asks for the minimum voltage that breaks the fault down.

Does the cable need testing after repair?

Yes. IEEE 400-2023 recommends retesting after any fault repair (cl 5.3.3).

Does Megavar locate cable faults?

Yes, with TDR and thumper and acoustic methods, as part of its HV cable testing service. Call 1300 730 499.

Hire or Have It Tested

Have It Tested

Megavar's engineers carry out [HV cable testing and fault location](#) on XLPE and paper insulated cables across Australia.

Next Step

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