



INTRODUCTION TO

TROUBLESHOOTING 2-WIRE CONTROLLED IRRIGATION SYSTEMS



A Training Series for Professionals

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Who is Armada Technologies?

- **Founded in 2004**
- **Based on 40 years in the Test Industry**
- **NOT irrigation professionals! (That means you know more than I do about water and light)**
- **We do know LOTS about Testers.**



OBJECTIVES

- Technical Terminology
- System Types
- Troubleshooting Goals
- Tools Available
- How to Use the Tools



PRODUCT GROUPS USED

Pro48



Pro93

WATER AND LIGHTING SYSTEM TEST & MEASUREMENT



Pro30

Pro800



Pro300



LOCATING BURIED WIRING AND VALVES



GFL3000

Pro400

TROUBLESHOOTING BURIED WIRING

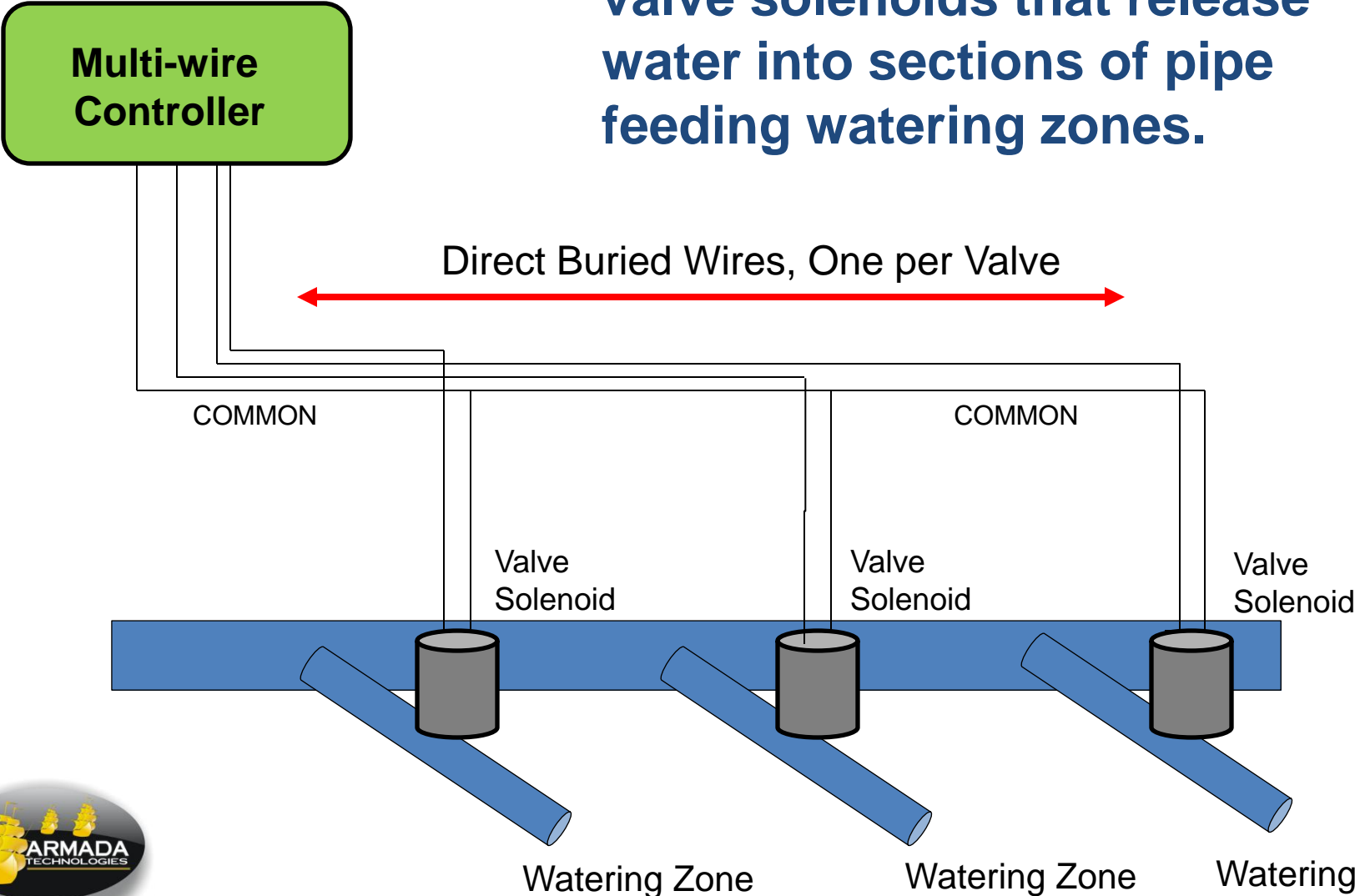


IRRIGATION SYSTEM TYPES

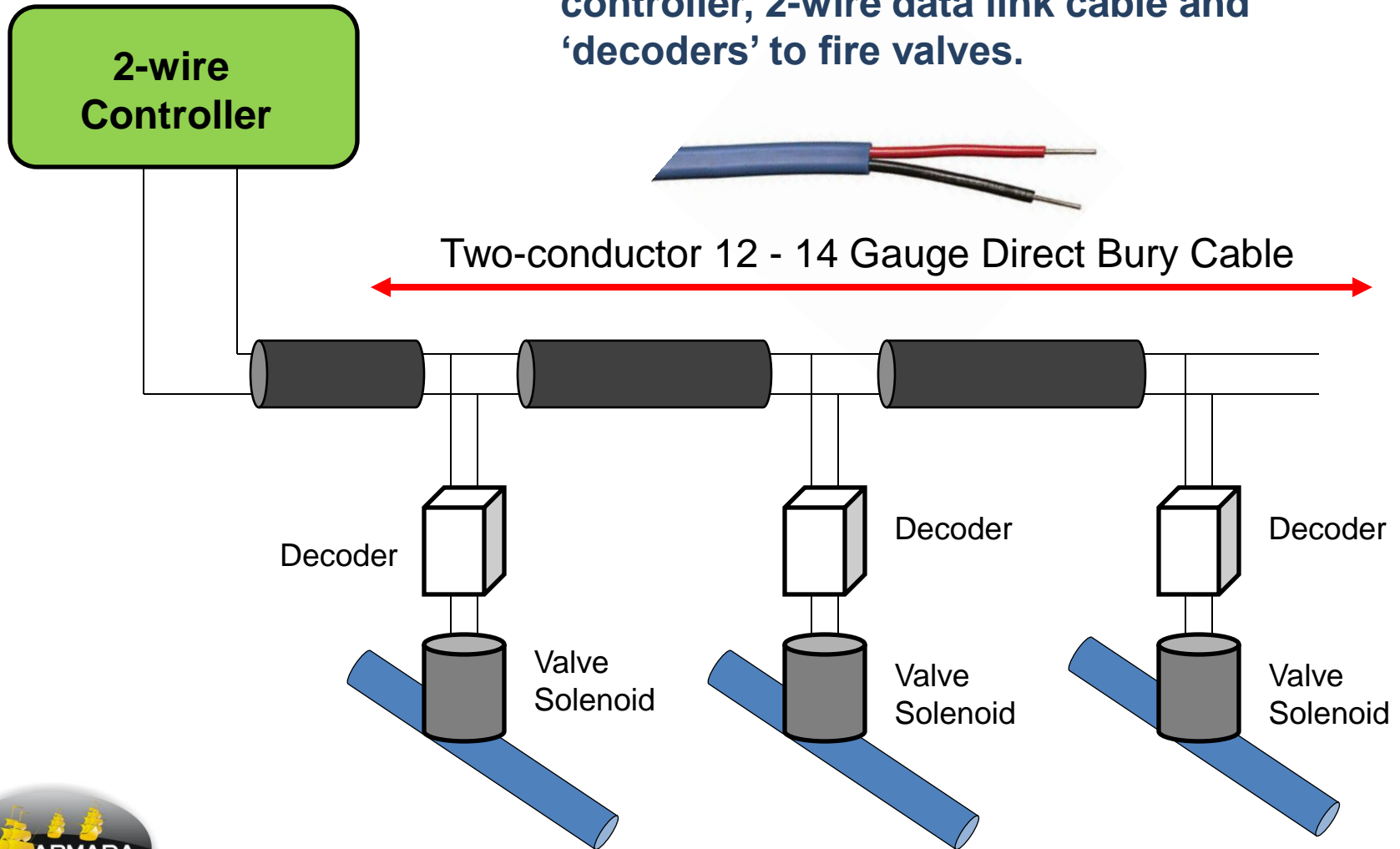
- Multi-wire (Wire-per-valve plus common)
- Two-wire (Single control+power)



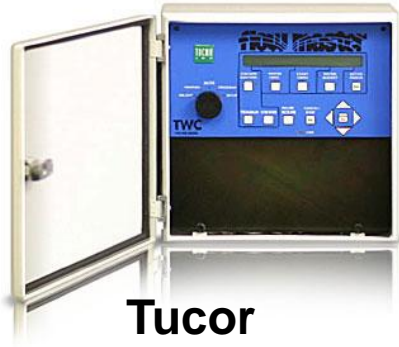
Clocks or controllers fire valve solenoids that release water into sections of pipe feeding watering zones.



Many newer, long distance, many-valve system designs often use a smart controller, 2-wire data link cable and 'decoders' to fire valves.



Some Two-wire System Vendors



Tucor



Toro



Hunter



Baseline

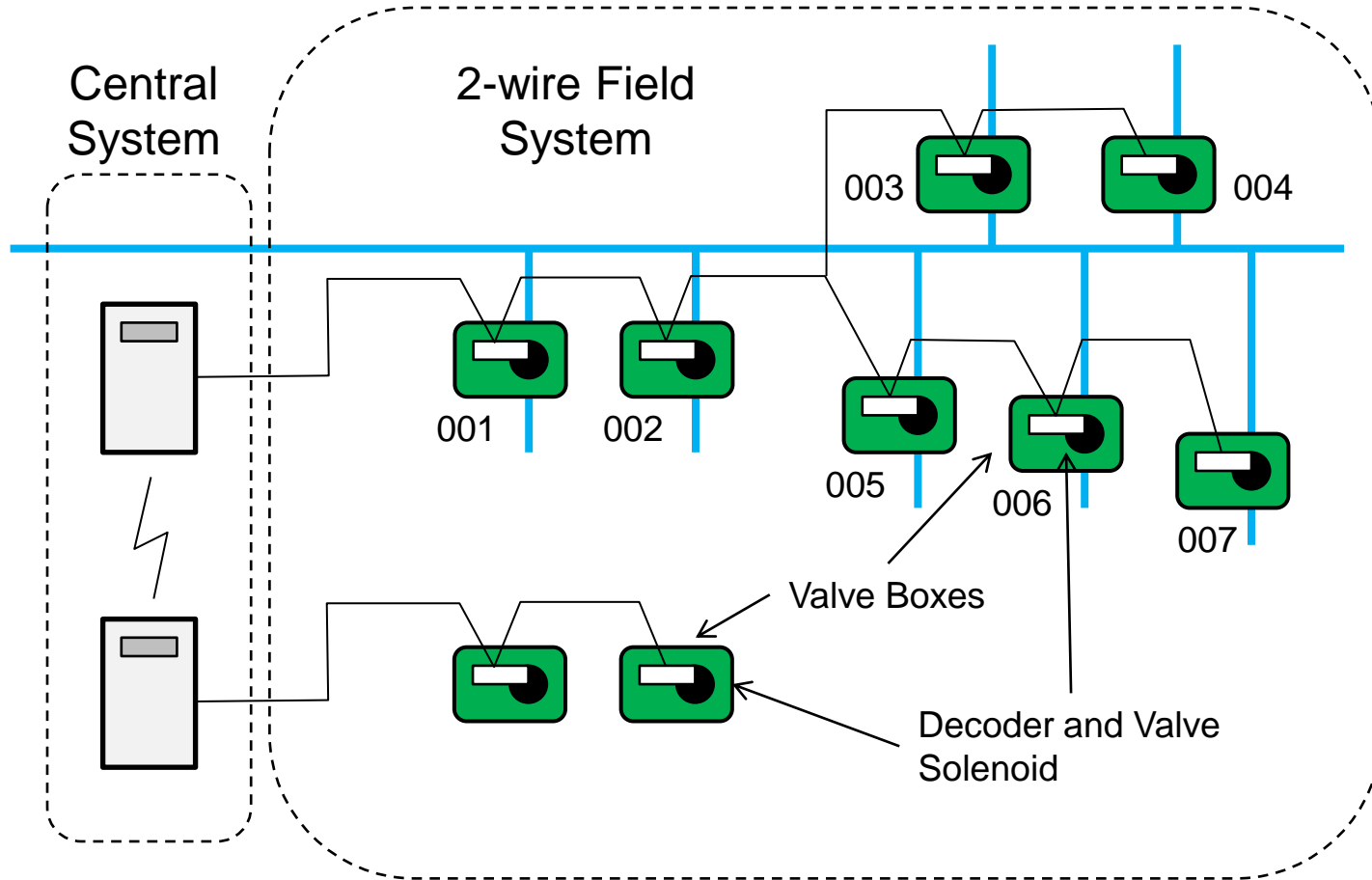


Weathermatic



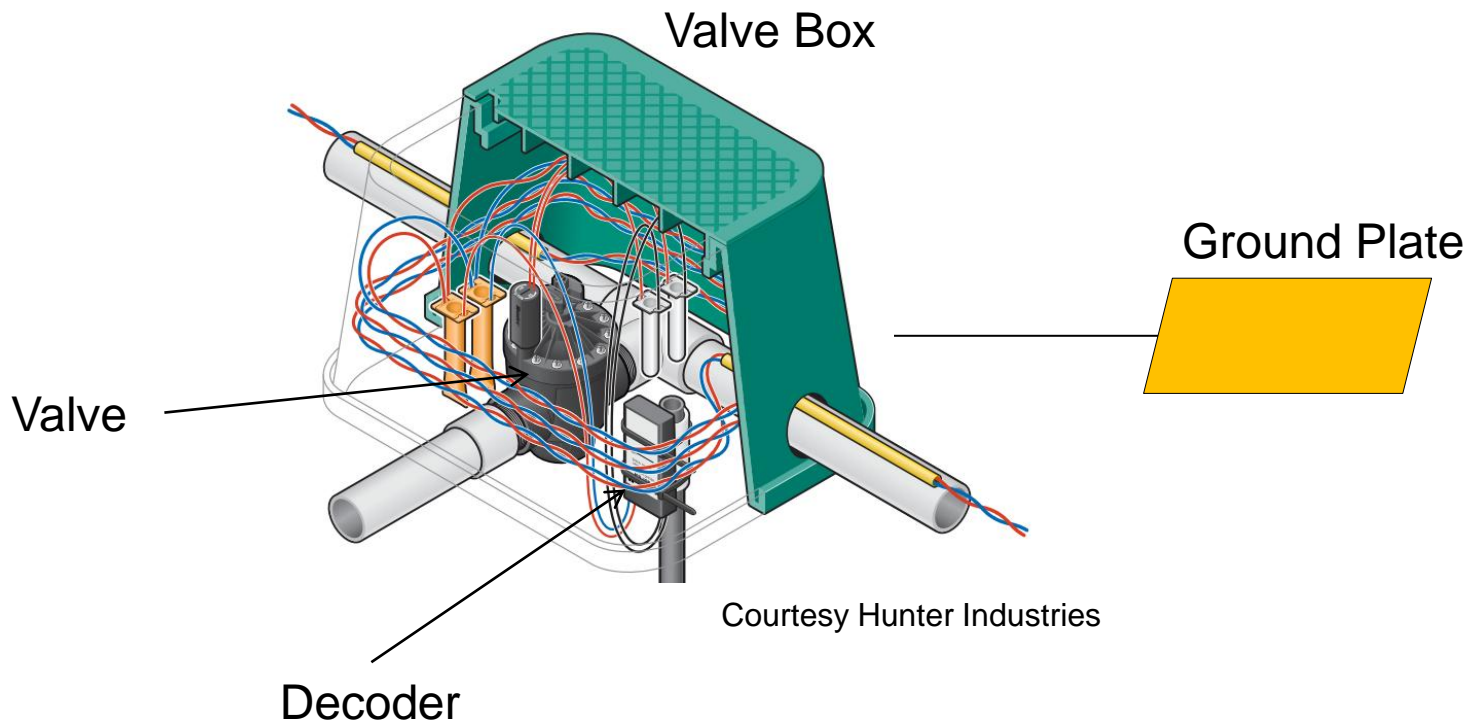
Rainbird





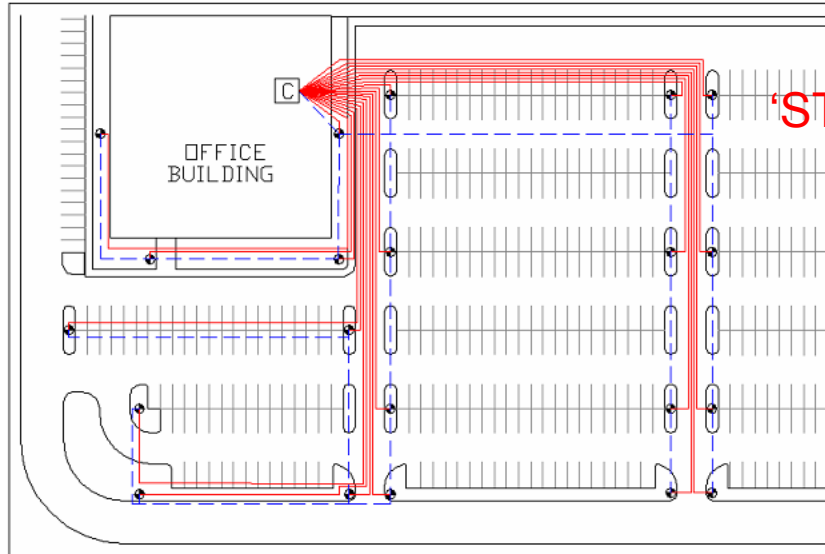
In a 2-wire system a single cable can control many valves.





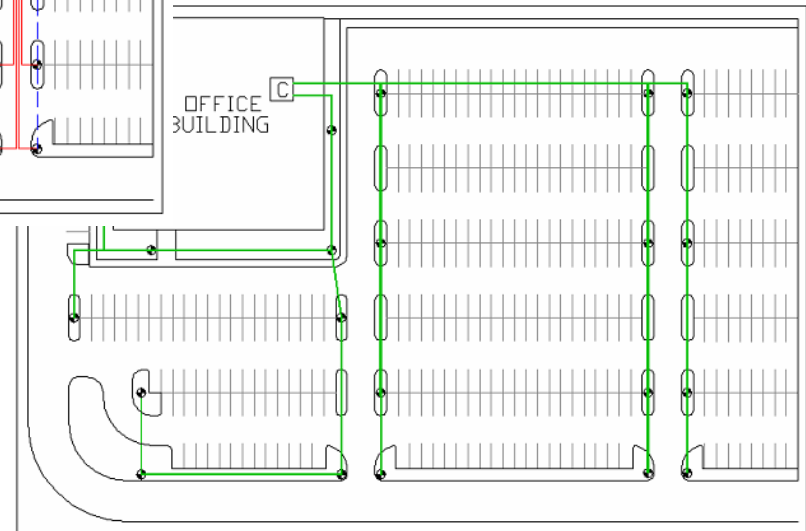
Buried Wiring for Conventional Multi-wire vs. Two-Wire Systems

CONVENTIONAL CONTROL SYSTEM



'STAR' or 'HOME RUN'

TWO-WIRE CONTROL

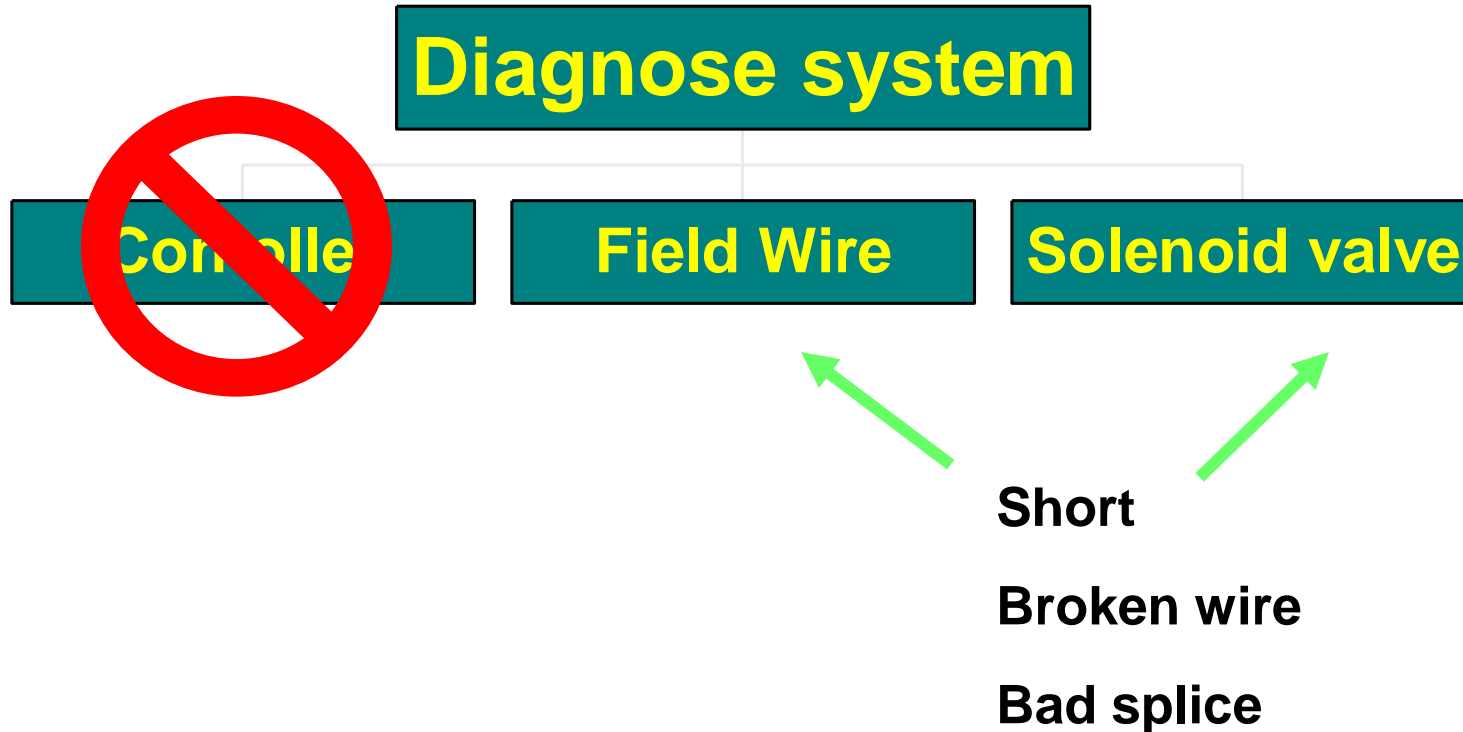


'DAISY-CHAIN'

Diagrams from Tucor



USING ELECTRONIC TESTERS TO ELIMINATE SUSPECTS



**Start by eliminating the controller
or water supply as the source of
the problem.**



TROUBLESHOOTING

As with any type of irrigation control system, start from the source of power and work outward

1. Controller
2. Field Wire
3. Decoders
4. Valve Solenoids



FIND THE WIRE PATH



Pro800D
Locator

Good Range
Direct & Antenna Connect



CHECKING DECODER CONNECTIONS

Pro93
True RMS
Clampmeter



High Sensitivity
True Power Reading
Type Recommended by Sys Mfgs
Not Carried by Other Suppliers



Pro400
TDR Wire
Radar

Measure cable length
Find distance to splices
Spot opens and shorts



FIND THE WIRE DAMAGE



GFL3000
Ground Fault
Locator

Fast, Precise Damage
Location

Price

Easy-to-use,
Multi-purpose,
clampmeter
and multimeter



Pro90

True RMS reading
for LED lighting, easy to use



Pro91

Hi Sensitivity and **True RMS** reading
For 2-wire irrigation and
LED lighting



Pro93



General
Purpose
Multimeter

Pro30

General Use

Advanced Features



METER SELECTION GUIDE

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TYPICAL USES FOR A METER: Checking an Irrigation Controller Zone with the Test Probes

CONDITION?

Short circuit

Open circuit

Partial Open (Bad Splice)

Normal solenoid

RESISTANCE READING

1 – 10 ohms

“OL” – Too big to read

70 – 150 ohms

20 – 60 ohms

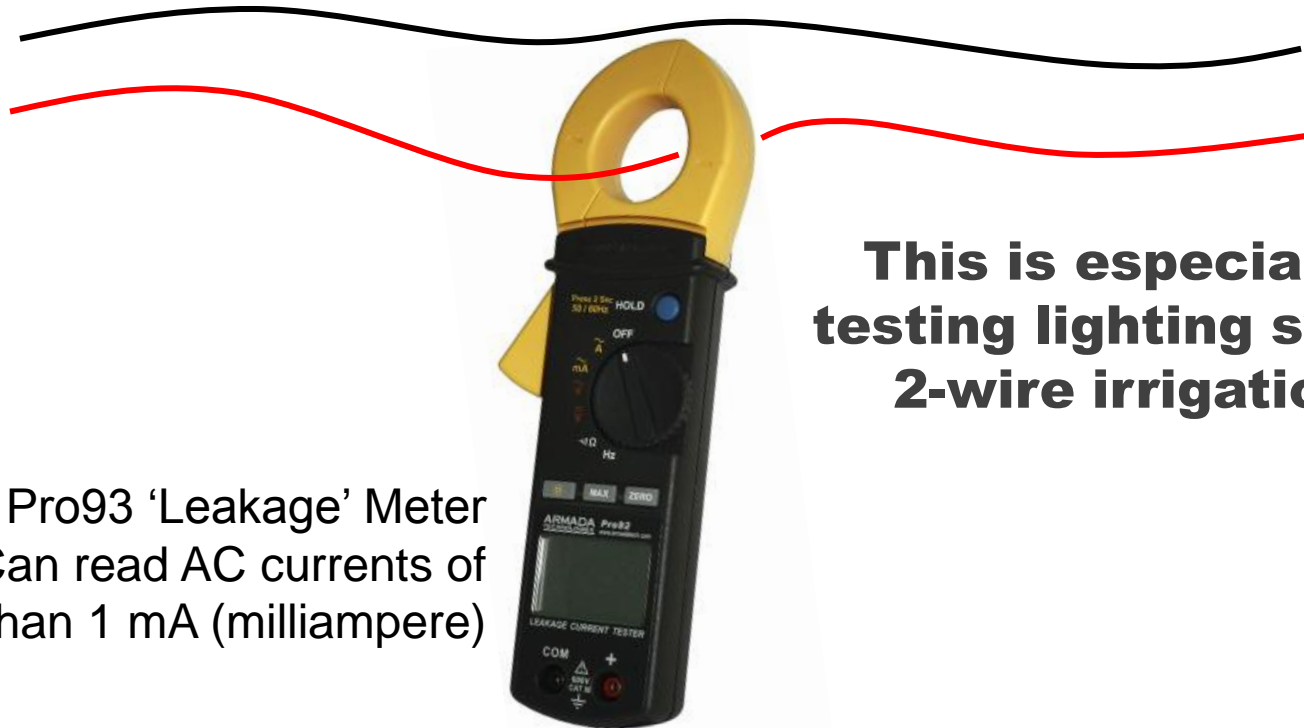
VOLTAGE READING

Normal Clock Output

24 – 36 volts



Clampmeters can measure electrical current by just closing the spring-loaded jaws over a wire.



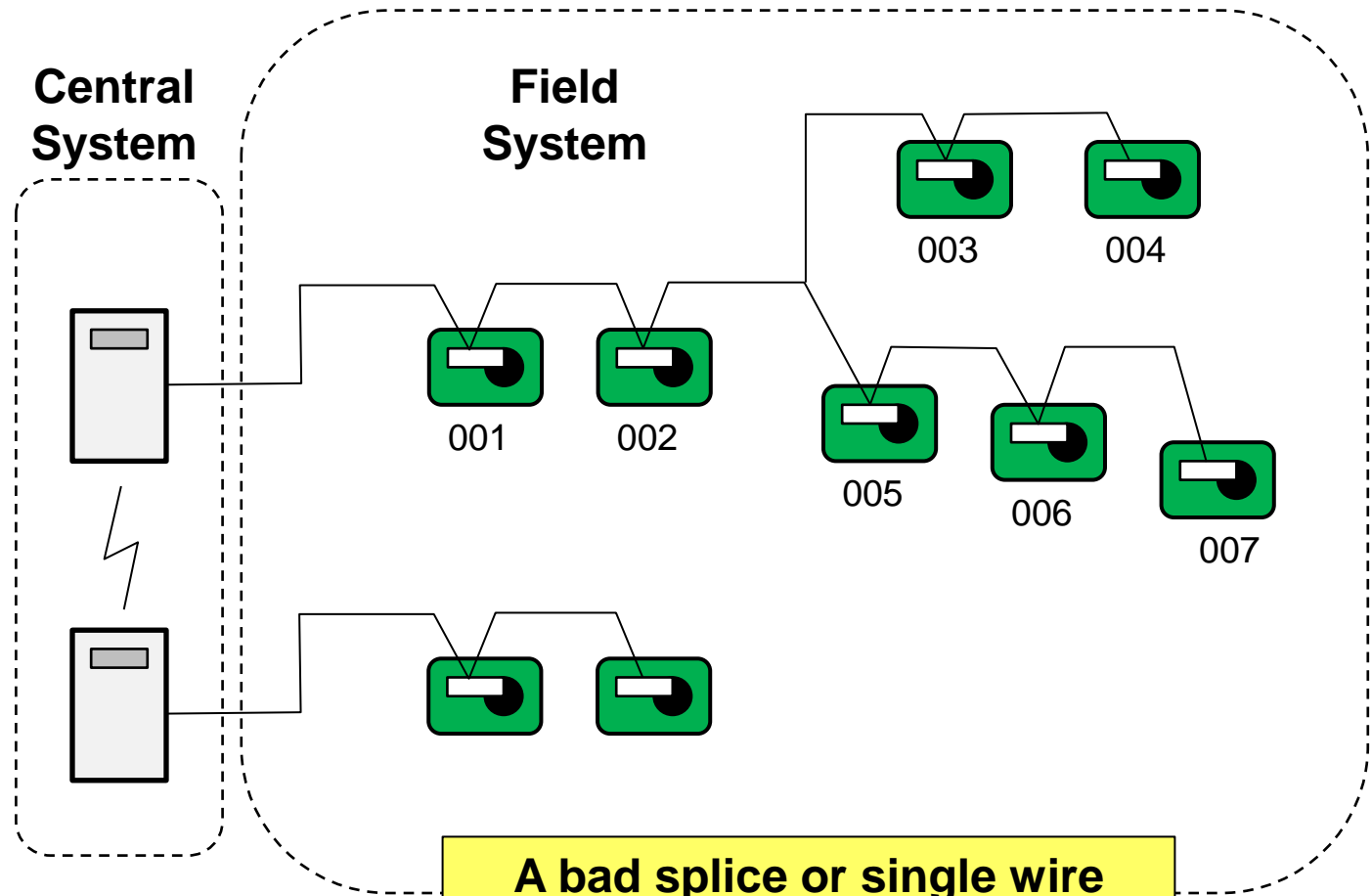
This is especially useful in testing lighting systems and 2-wire irrigation systems.

Pro93 'Leakage' Meter
Can read AC currents of
less than 1 mA (milliampere)

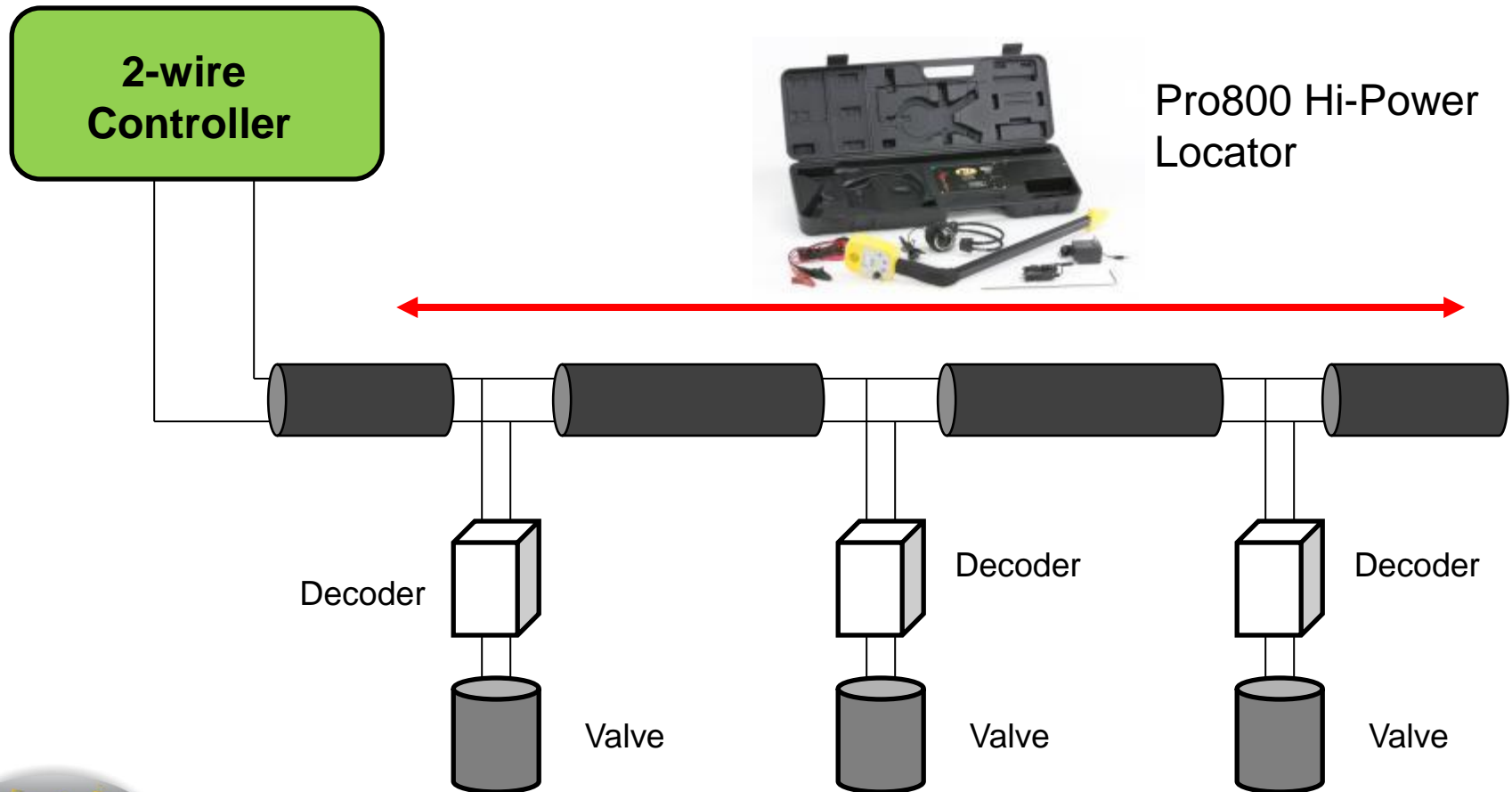
Check electrical currents one wire
at a time.



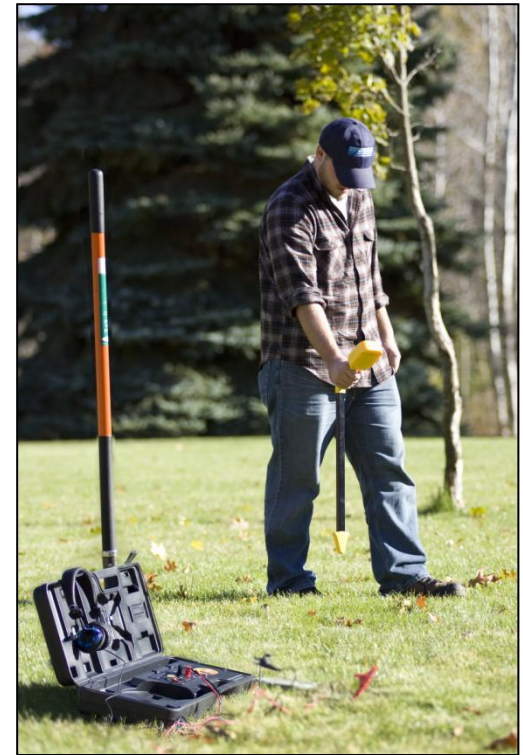
2-Wire Control Links are Chains of Smart Valve Solenoids Wired in Series, Each Identified by an ID Number



To Begin With, You Need to Know the Route of the Buried Cable and Locations of Valves

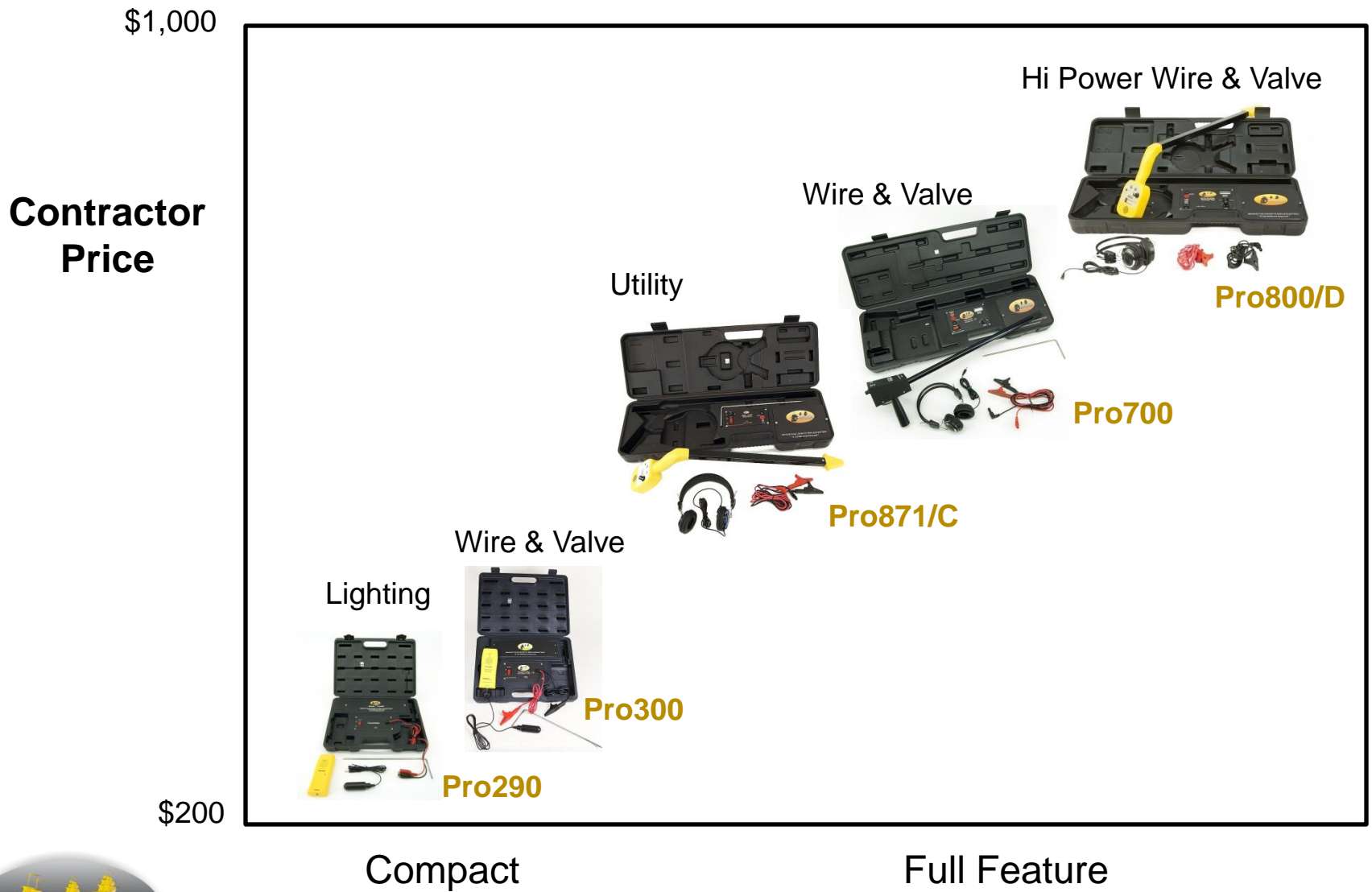


Locating Buried Cables and Pipes is Part Science, Part Art.

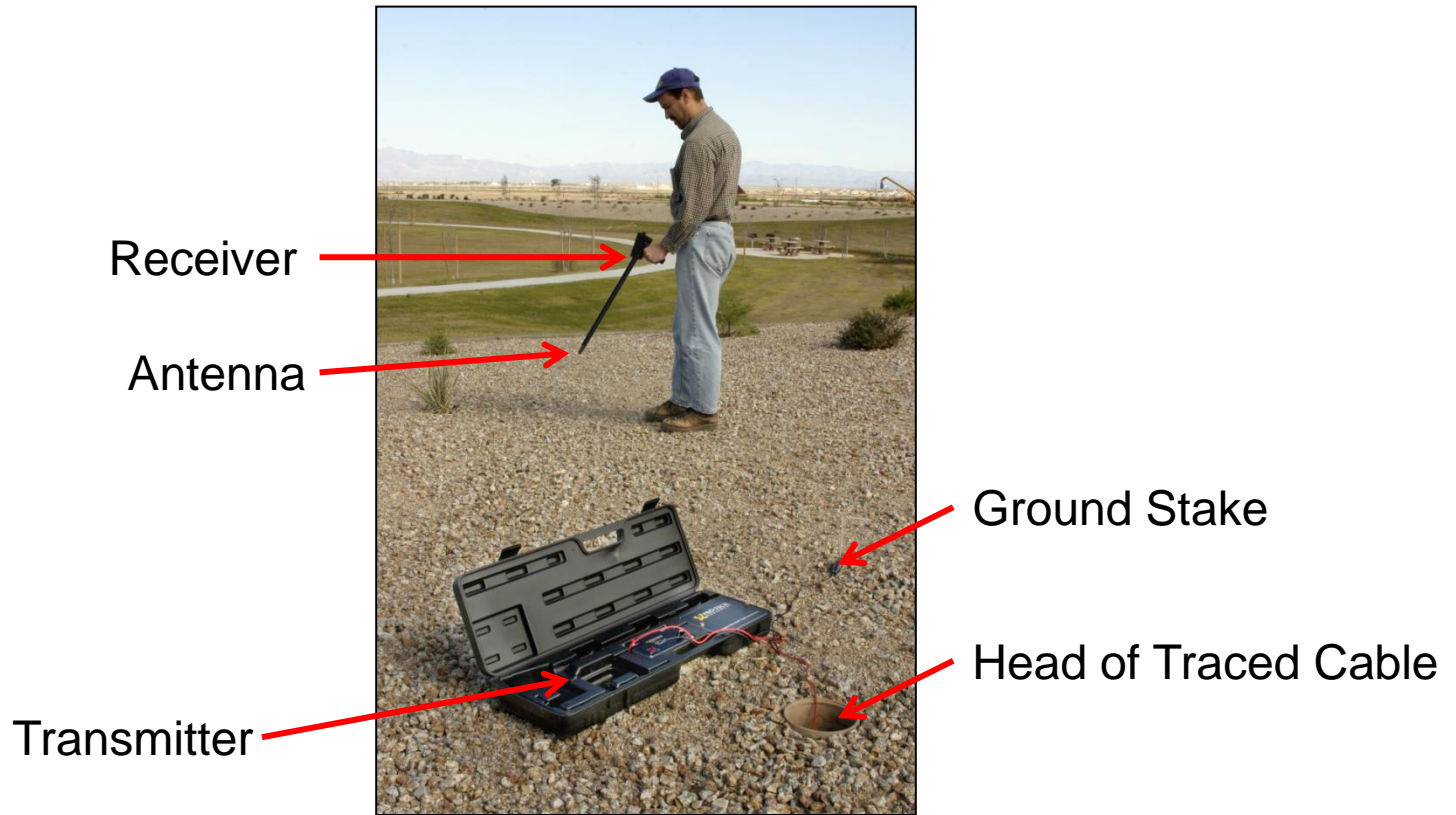


Modern electronics have made it simpler and less expensive.



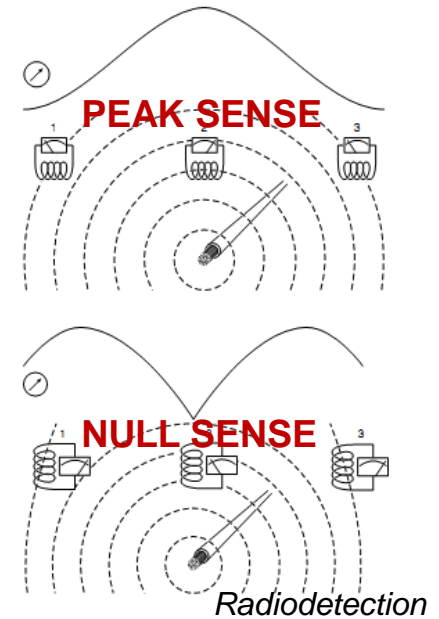
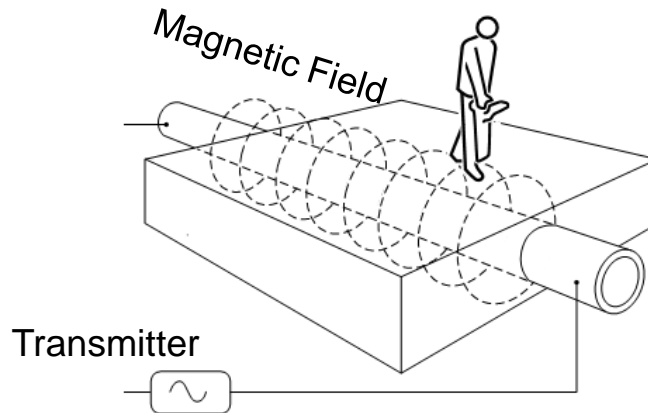


The Parts of the Locating Process.

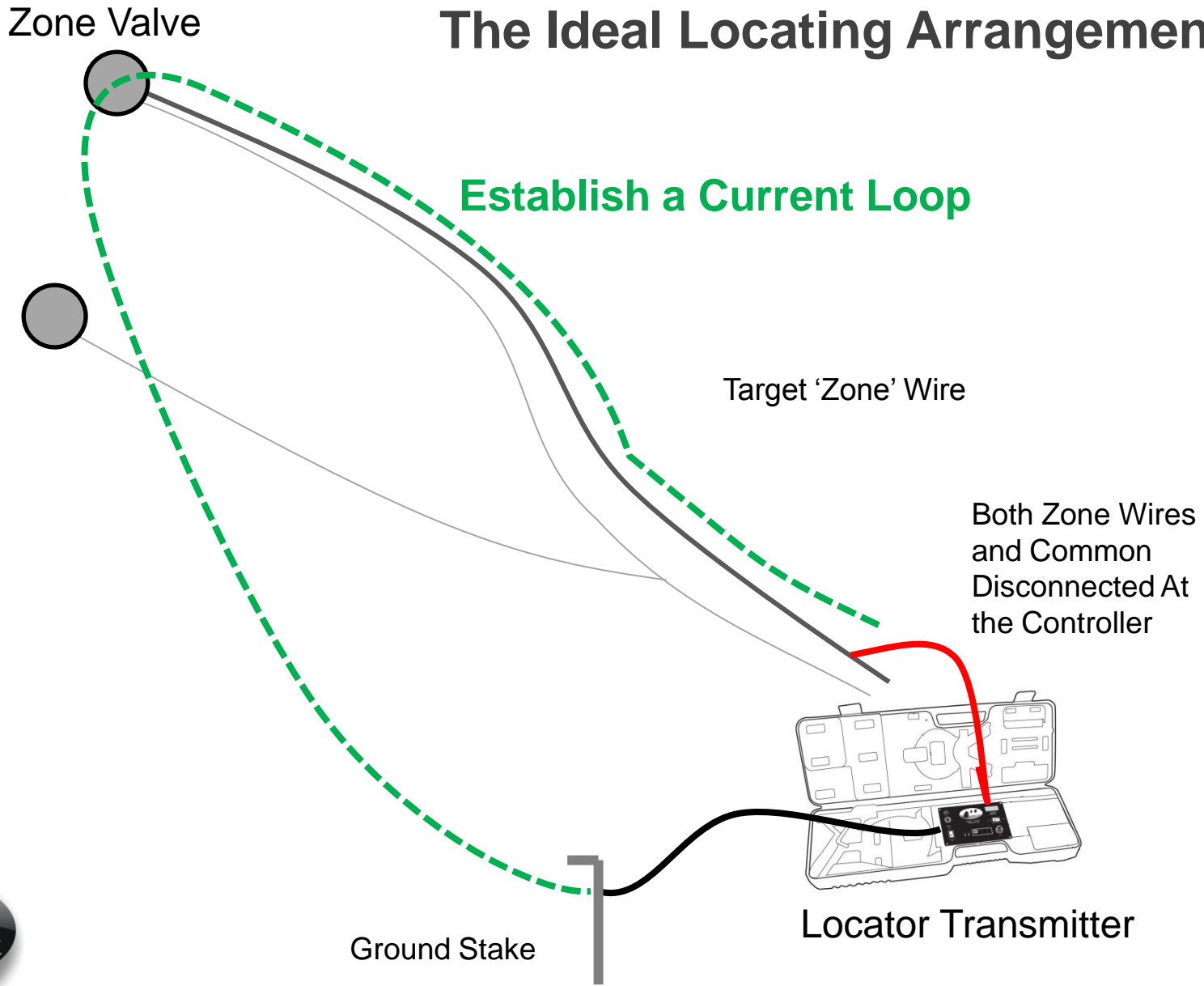


Locator Features and Uses

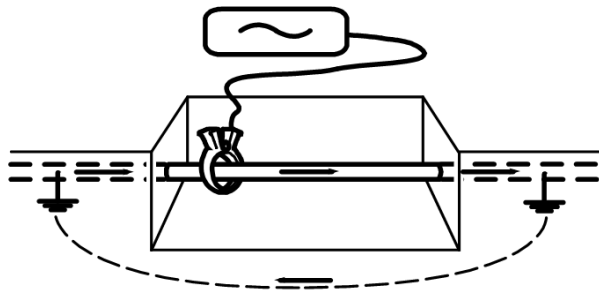
- Transmitter Power (range & depth)
- Transmitter Frequency (range)
- Signal Connection – Direct or Magnetic (cable access)
- Receiver Antenna – Peak or Null (spot location)
- Depth Measurement (spot location)



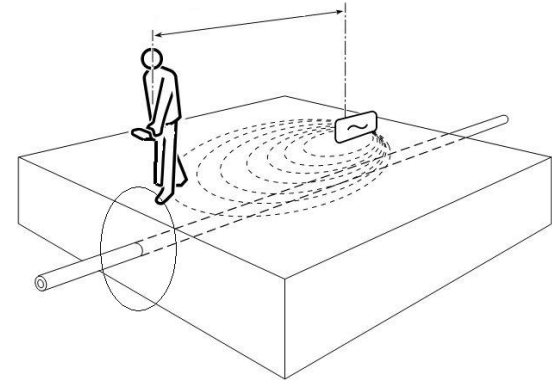
The Ideal Locating Arrangement.



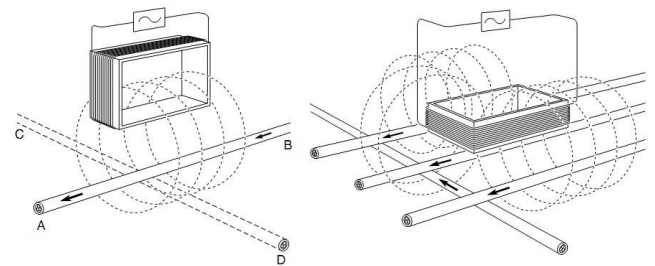
Locators put their 'tag' signals on by directly connecting to the wires, clamping a transformer jaw around a cable or by broadcasting a field into the ground.



Clamp Method



Broadcast Method



Radiodetection

Direct connection to the wire or cable is the best.



Cable Locating Tips

- Size up the situation, look around for signs that will give you clues about cable routes.
- Make a sketch of the area and notes on the equipment you see.
- Look for locating marks like flags or paint, and be prepared to make your own marks.
- Whatever you are told about what is in the ground and where it goes, be skeptical.
- Remember as you start to locate that success is 50% science and 50% art (experience).





TEST EQUIPMENT FOR
GREEN PROFESSIONALS

**IRRIGATION
SYSTEM
DIAGRAM &
NOTES**

DATE:

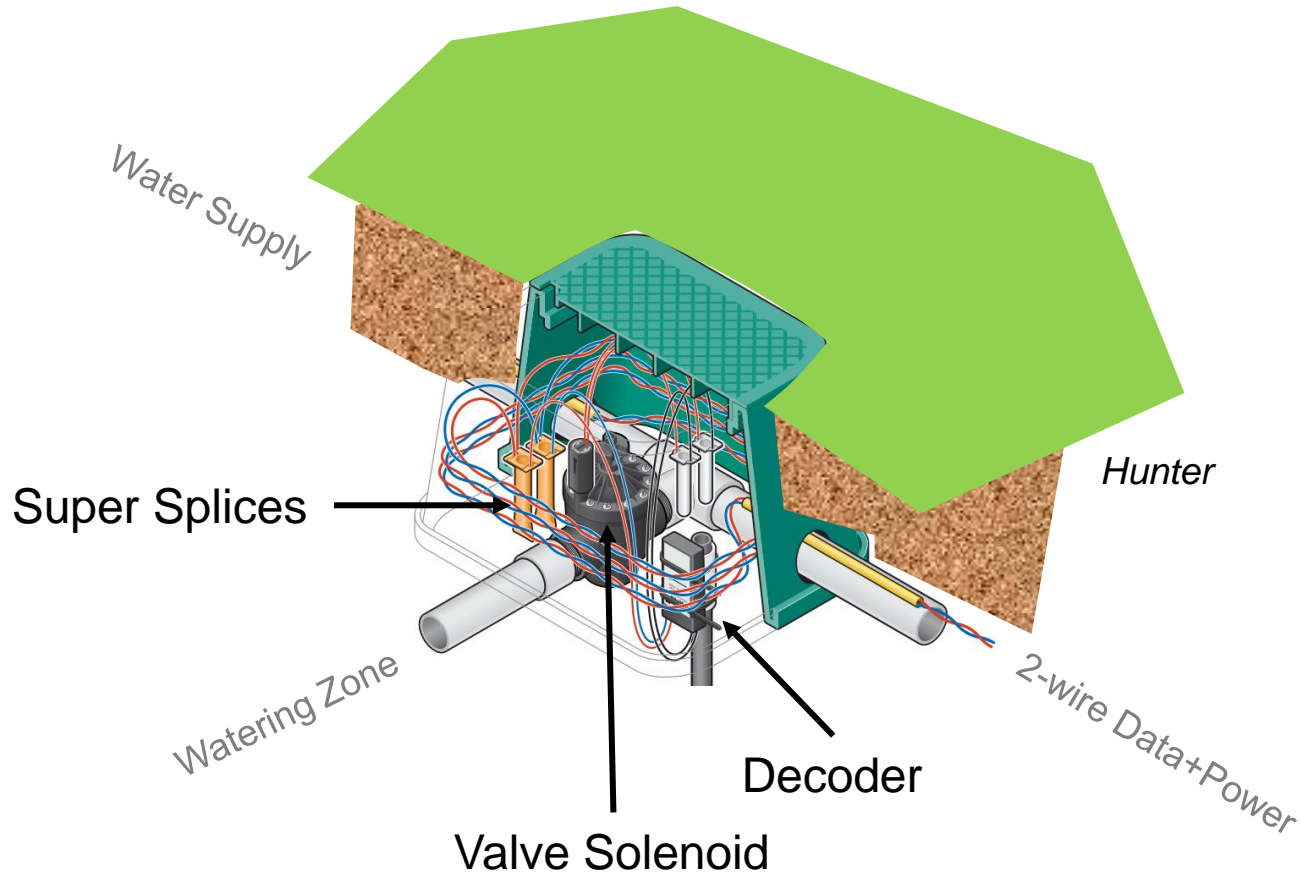
LOCATION:

PROBLEM:

NOTES:

Do yourself a favor -- take notes and
make a sketch of what you find.

TYPICAL 2-WIRE VALVE BOX



Splices are the weakest link in the field system.



The General Process



Controller

Controller On - Built-in Diagnostics check

Field wire powered – 30 to 36 volts, or 24 Vac test power unit

Field Wire

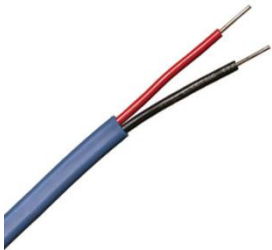
First disconnect and check resistance

Each wire to ground greater than 500 kilohm

Across wire pair greater than 100 kilohm

With controller on or in troubleshooting mode

check total powered loop current in each of the 2 wires

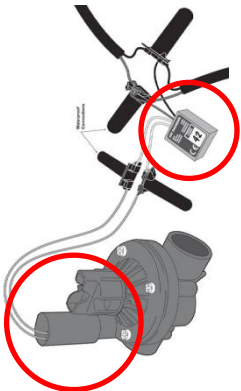


Decoders

Locate cable path

Locate valve boxes

Spot check power current passing through the box and going to the local decoder.



Valve Solenoids

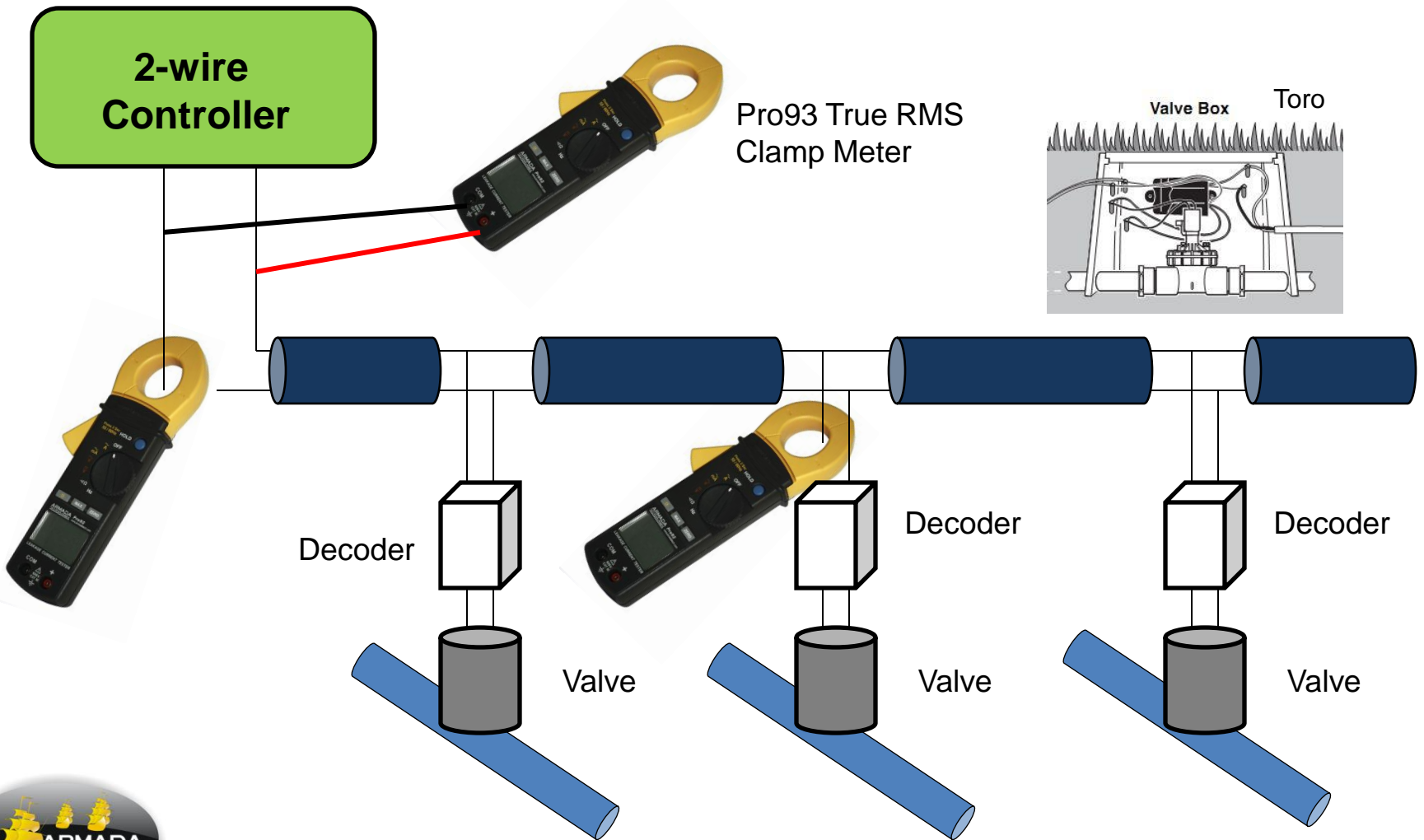
With water on do a manual bleed

Resistance check solenoid 20 – 80 ohms

Use Pro48 tester for solenoid operation check.



The Key to Finding Open Circuits or Shorts is a Sensitive AC Clamp-meter

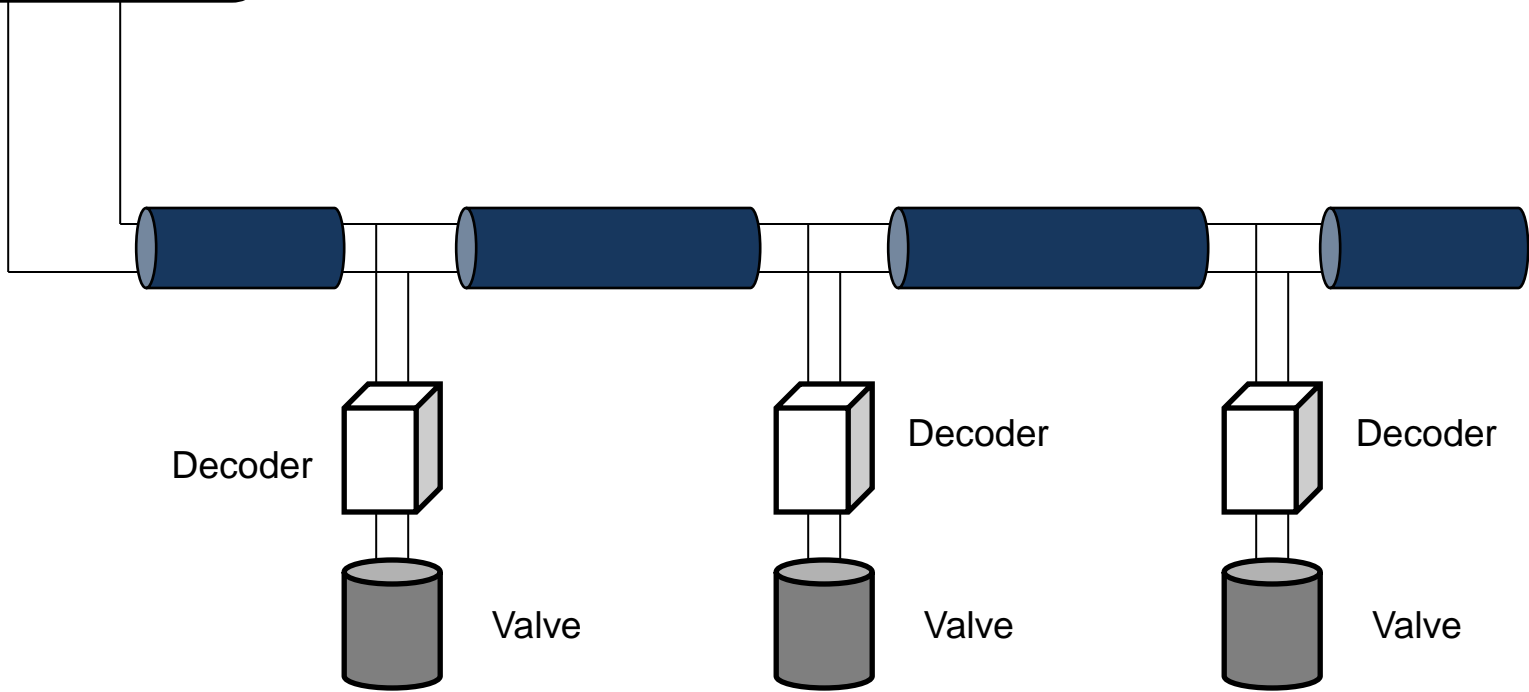




You Have to Power the Field Cable to Use a Clampmeter

2-wire Controller
(puts out about 35 V)

Test Power Unit
OR (puts out about 24 Vac)



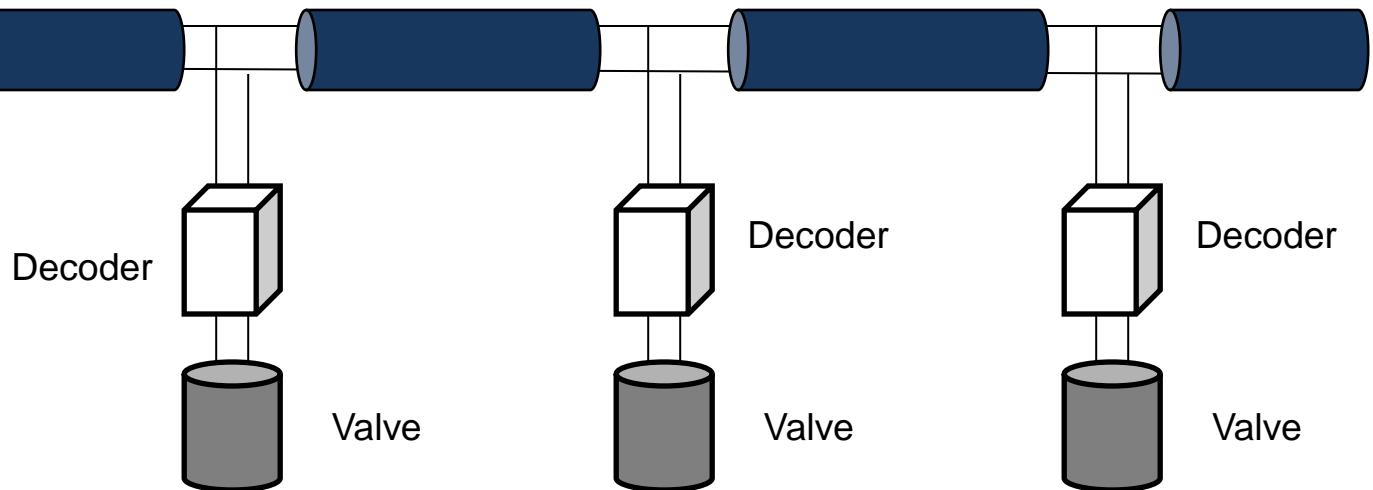


**Test Power Unit
(puts out about 24 Vac)**

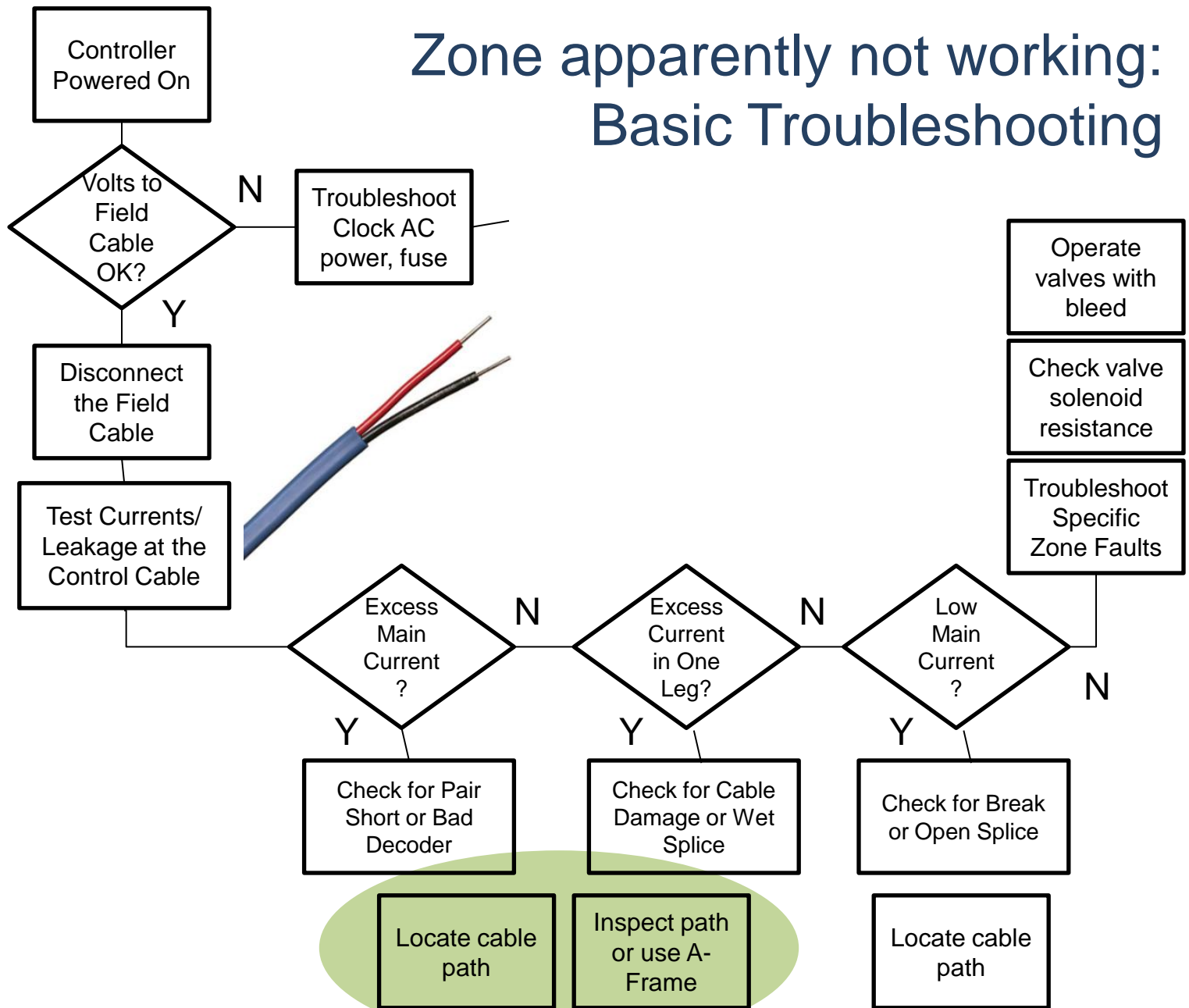
You Can Use the Power Unit and Clampmeter to Check for Faults

With the test power connected to the wires the clampmeter around both wires should show zero current.

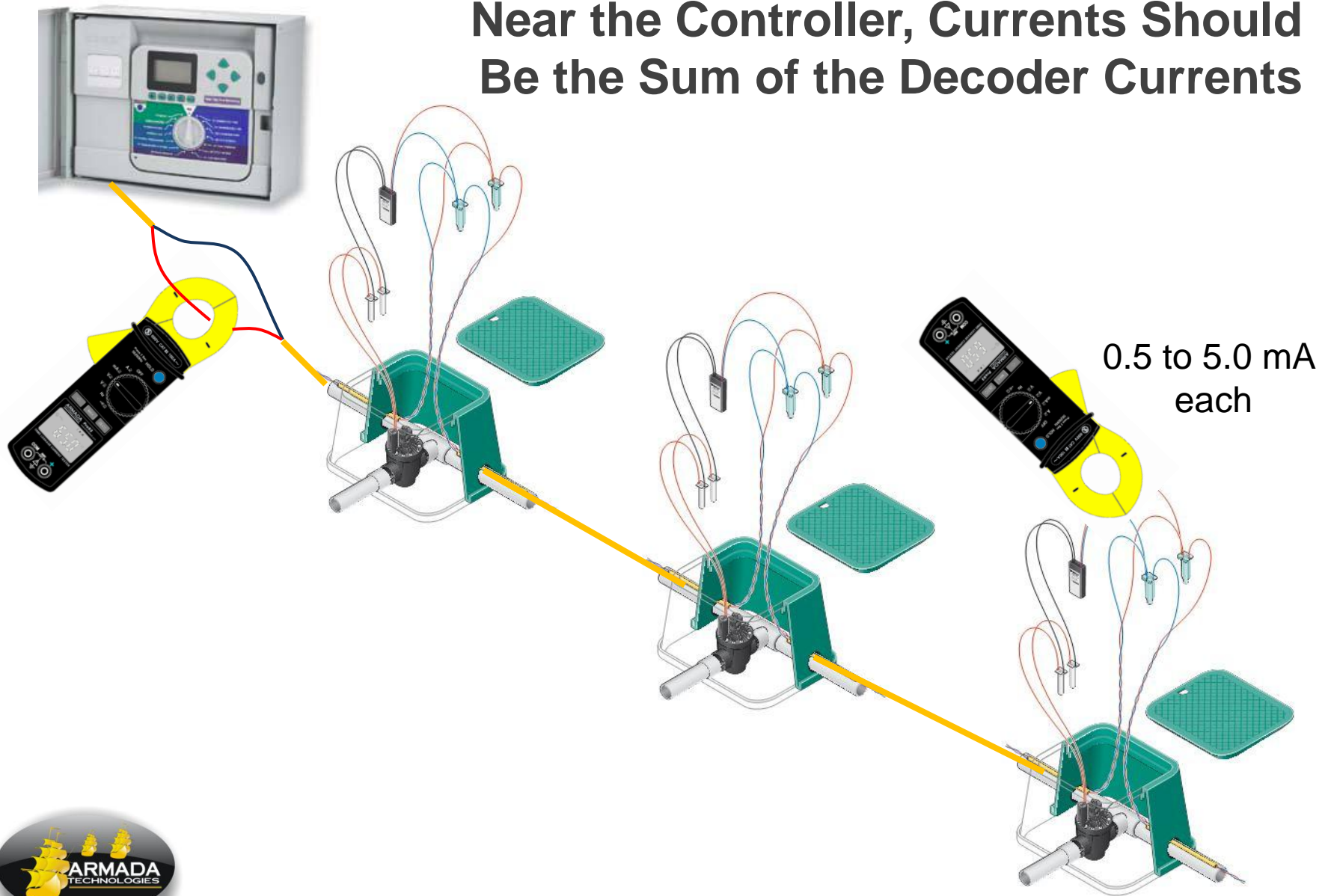
The current between either wire and ground should be less than 50 mA



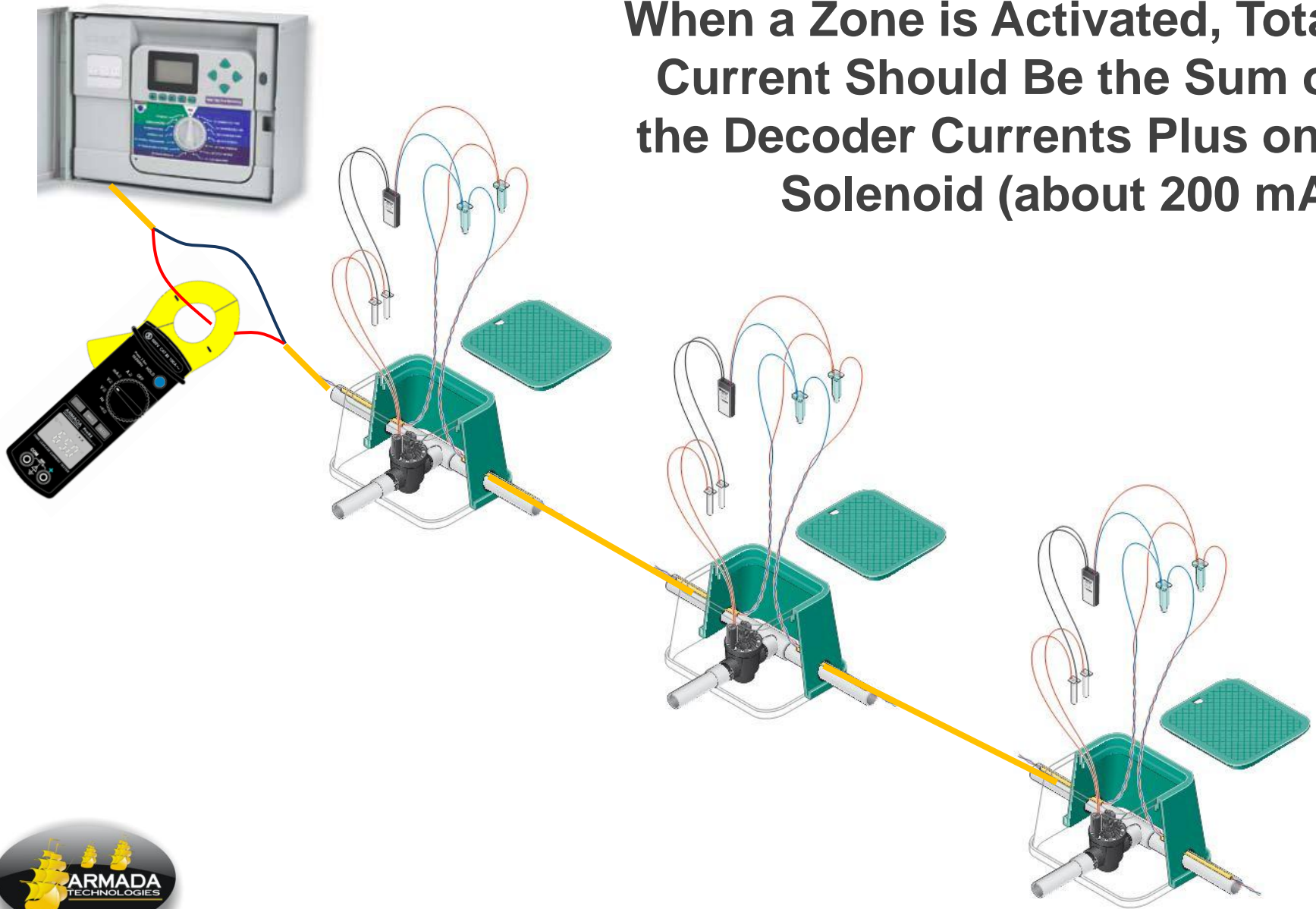
Zone apparently not working: Basic Troubleshooting



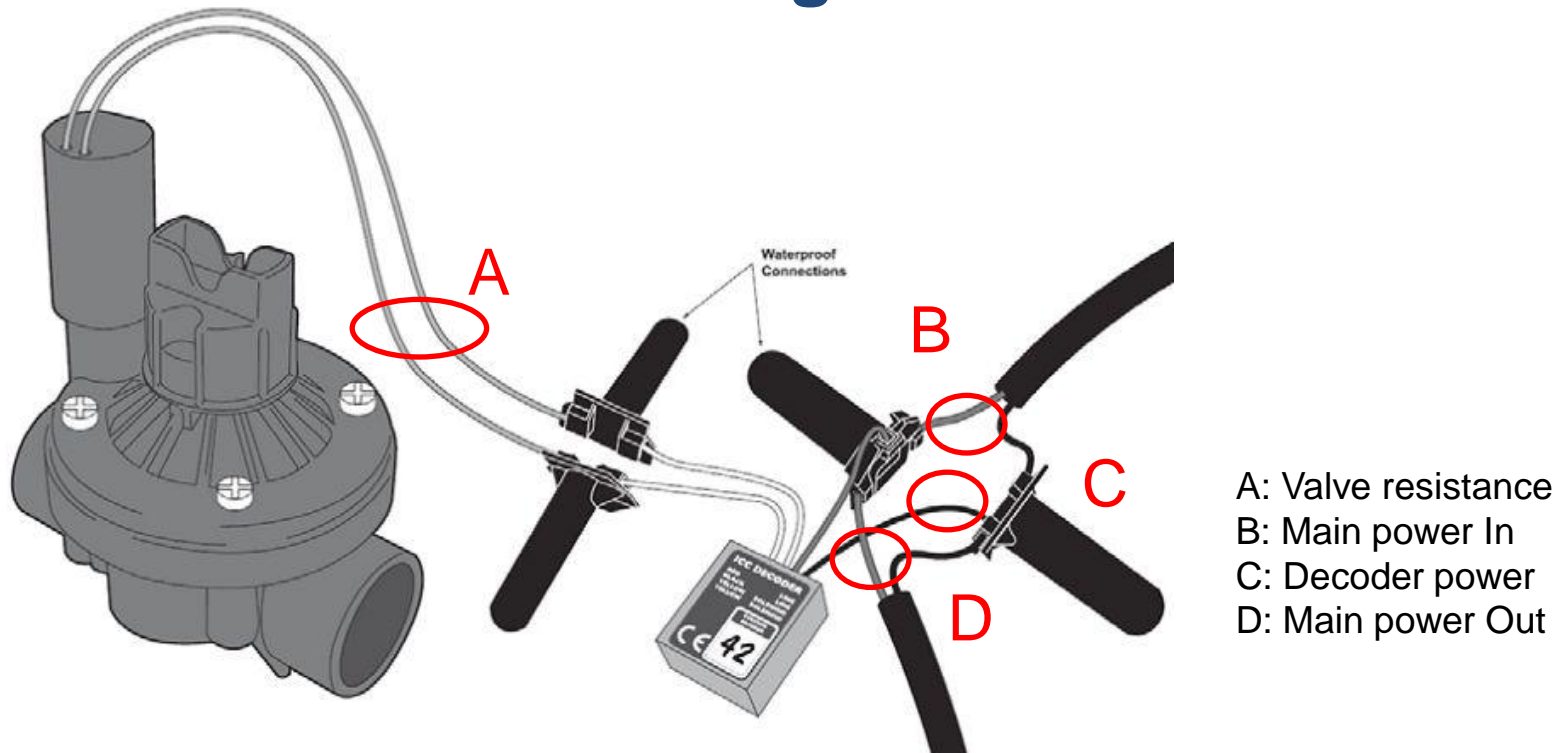
Near the Controller, Currents Should Be the Sum of the Decoder Currents



When a Zone is Activated, Total Current Should Be the Sum of the Decoder Currents Plus one Solenoid (about 200 mA)



Pro93 Clamp-meter Measuring Points in a Valve Box

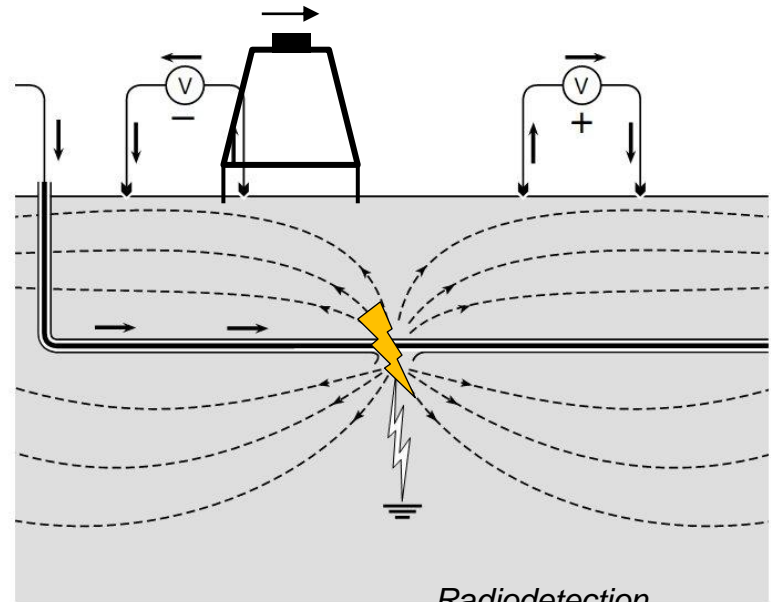
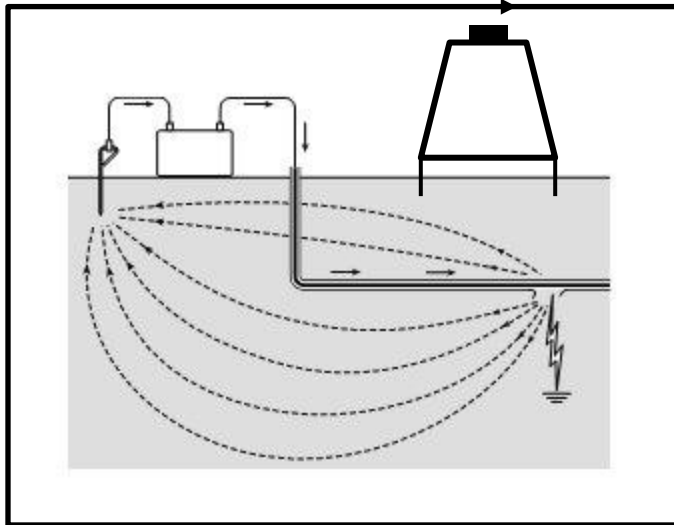


**Checking electrical power flow and
cable continuity means measuring
electrical currents.**



Finding a Break or a Nick in the Insulation.

The GFL3000 A-Frame isolates breaks in buried cable insulation.

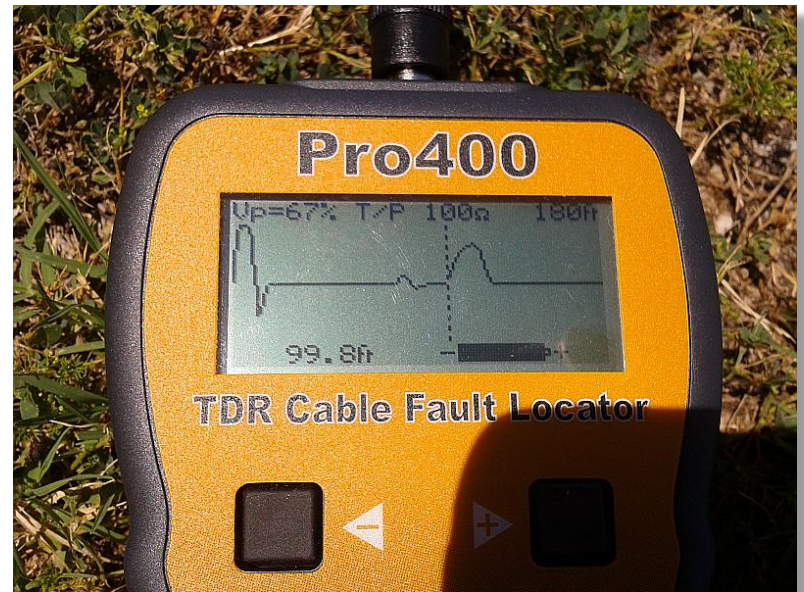


CHECK DISTANCES & FIND WIRE DAMAGE



Pro400
TDR "Wire
Radar"

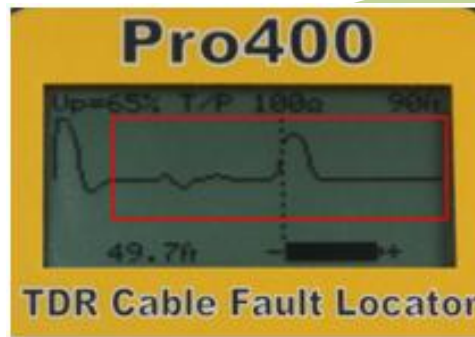
- Measure cable length
- Find distance to splices
- Spot opens and shorts



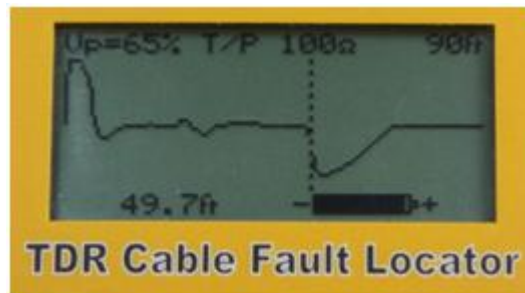
Example display: A valve solenoid 100 feet down the cable with a splice at 75 feet.



The Pro400 “Wire Radar” Examples

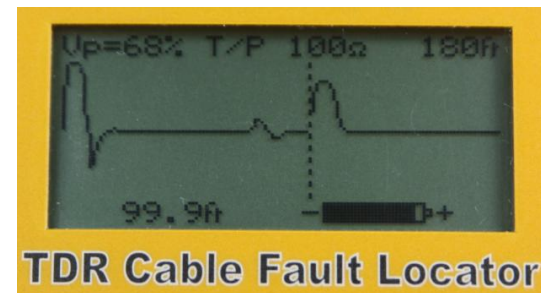


The key information appears in this area.



Short circuit
50 feet down
the cable.

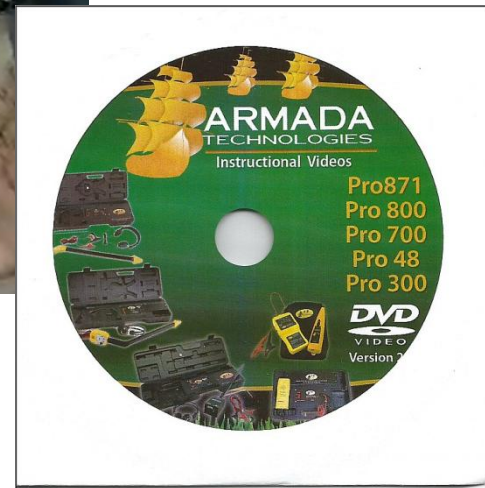
Cable open at
100 feet,
splice visible
at 75 feet.



**Once the cable correction factor ‘Vp’ is set,
you can read distances down the cable by
moving the cursor**



**Demo Videos are on DVD and
can Be Seen at www.armadatech.com**



Questions.

