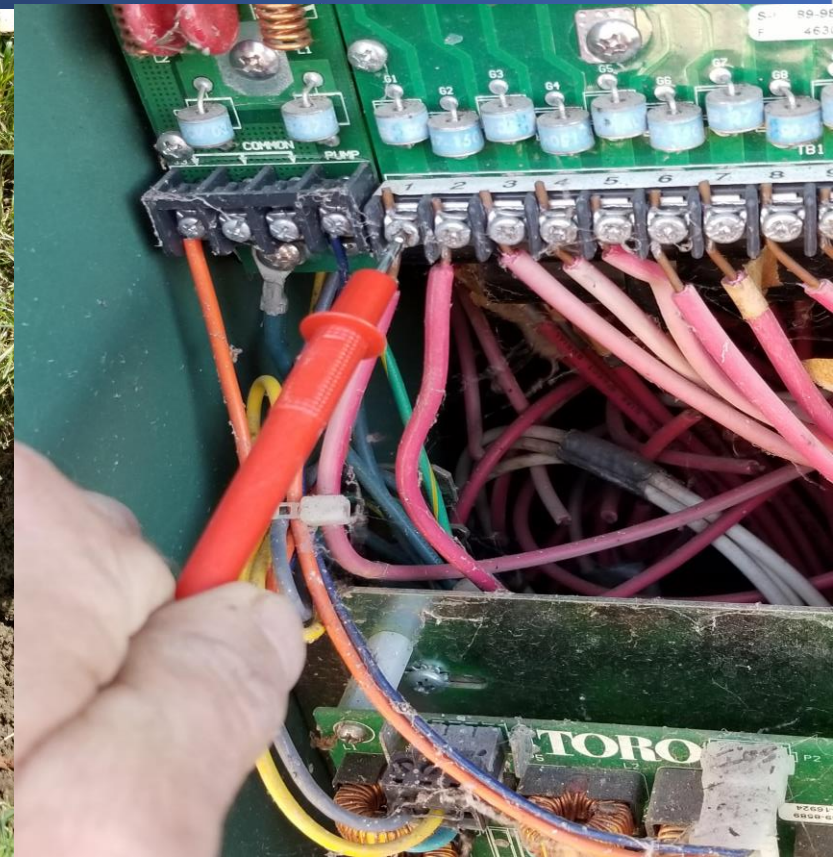


Troubleshooting Irrigation Using Sight, Sound, and Smell? and Maybe a Shovel Too

Brad Jakubowski



Introduction

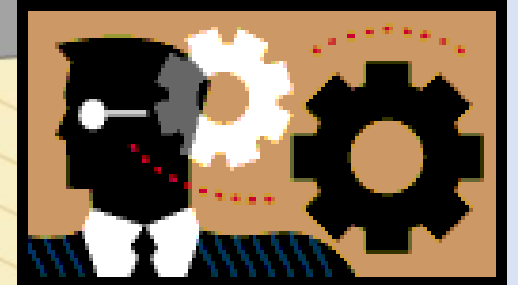
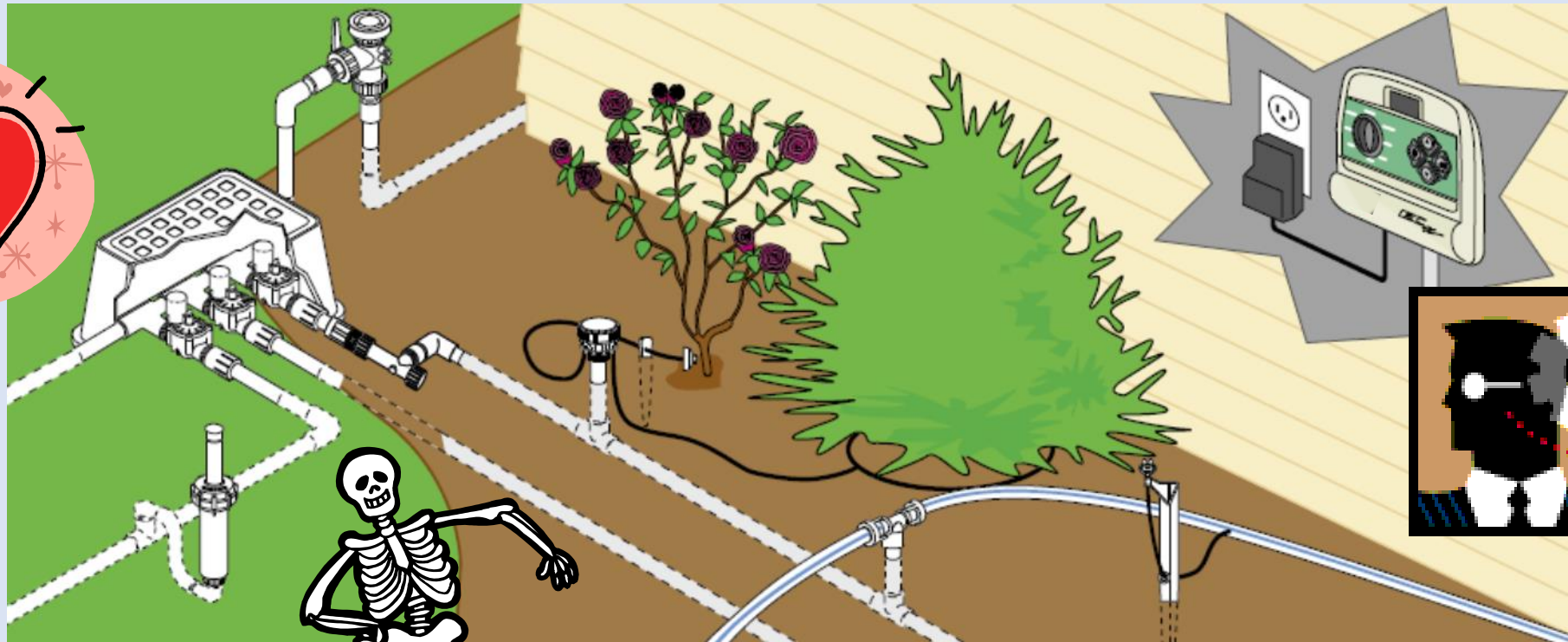
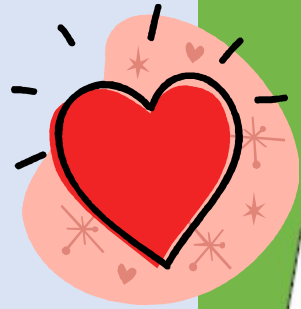


1. Study What You Have / Take Inventory
2. Learn How Your System and Sprinklers Work
3. Simplify the Troubleshooting Process
4. Check the Obvious, Use All of Your Senses
5. Dig Only When It's the Last Resort

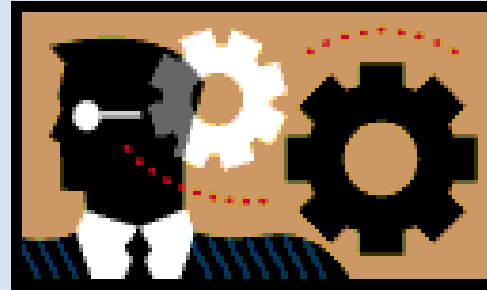
Study What You Have



Basic Anatomy...



Controllers – the Brain



- Commercial
- Residential
- Golf



What sensors do you have?

Rain Sensors



Wireless Rain-Clik
Wireless Rain/Freeze-Clik
Rain and Freeze Sensors



Flow-Clik
Flow Sensors



HFS
Flow Sensors



Freeze-Clik
Freeze Sensors



Wind-Clik
Wind Sensors



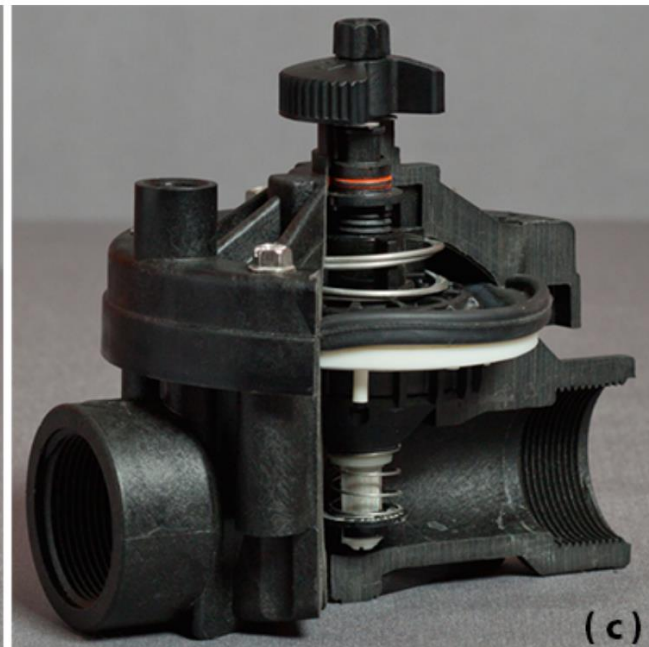
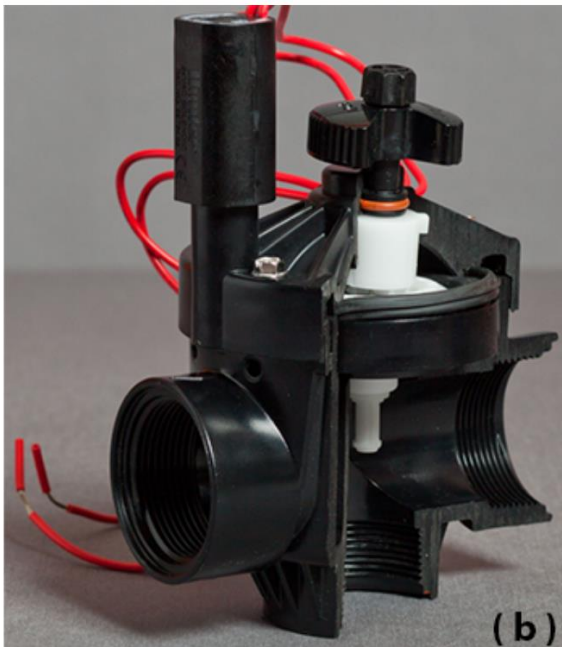
Mini-Weather Station
Rain, Freeze and Wind Sensors



Valves - Heart



- Brass
- PVC (plastic)
- Glass-filled nylon resin



Credit: (a-c) Greg Raymond / Penn State University

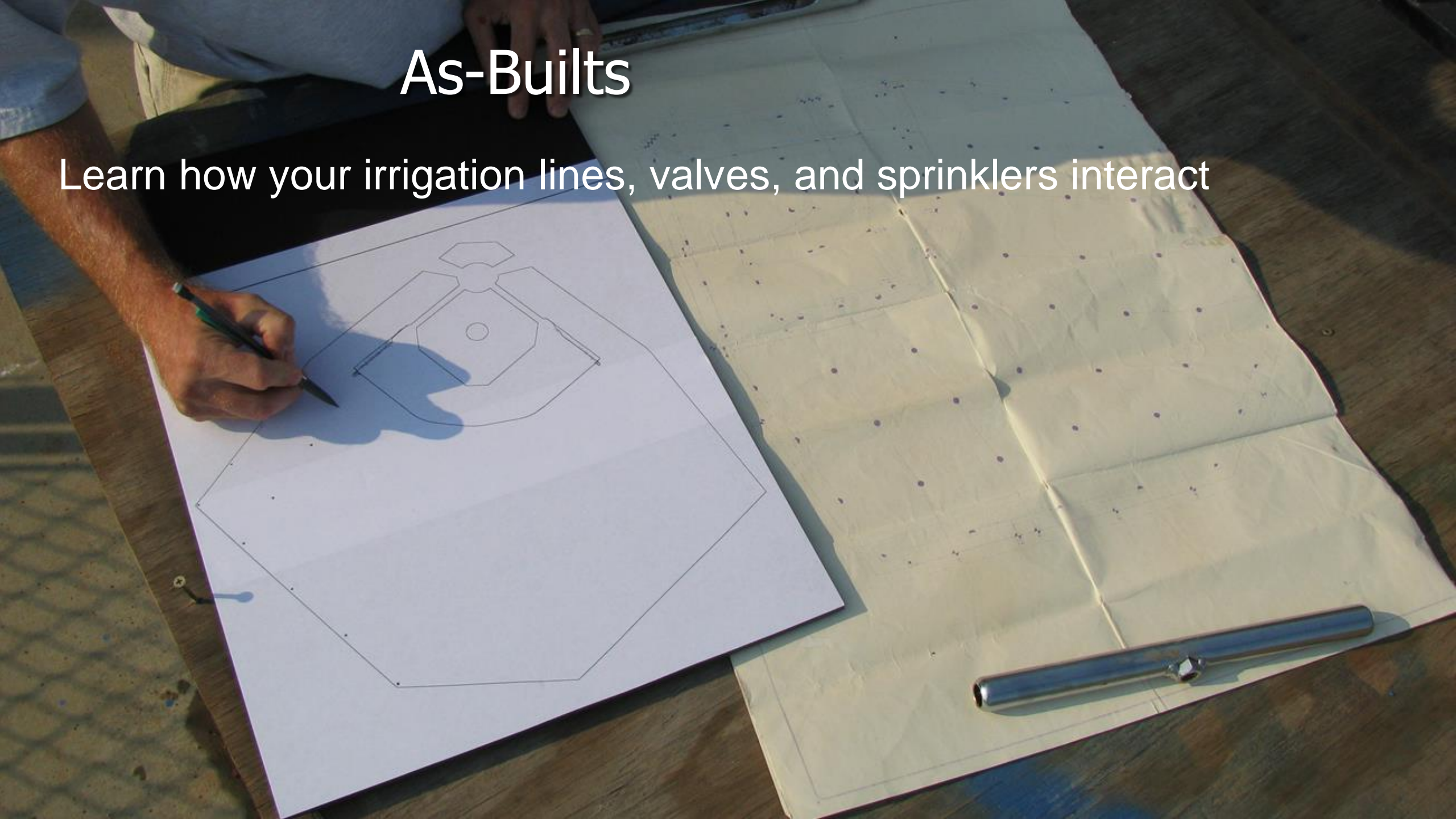
Proper Installation Practices?



**DBRY-6;
3M Connectors**

As-Builts

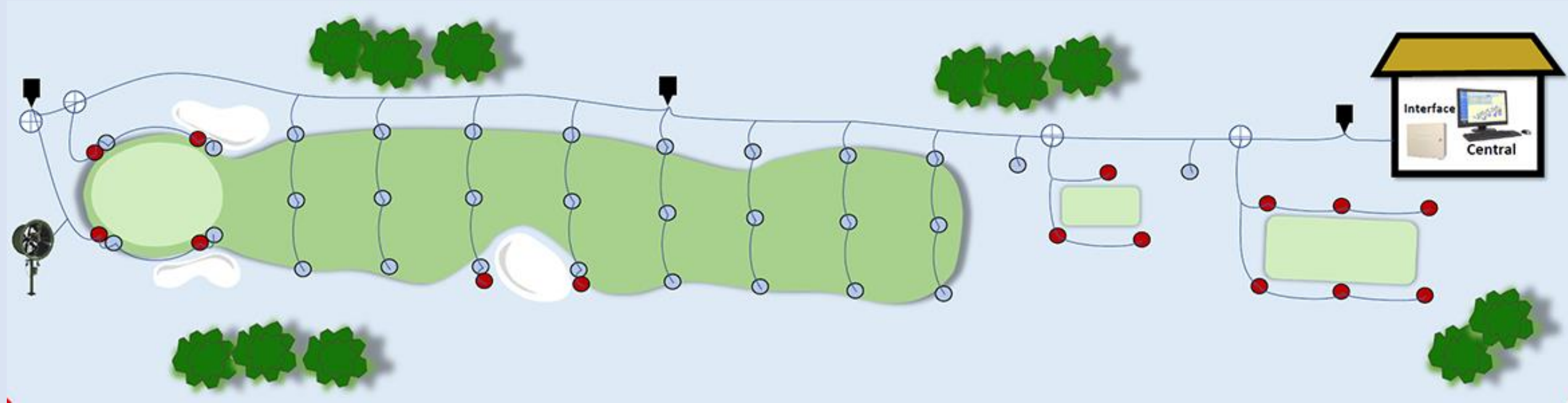
Learn how your irrigation lines, valves, and sprinklers interact



As-Builts



It is critical to include where electrical wiring was run and how it was connected





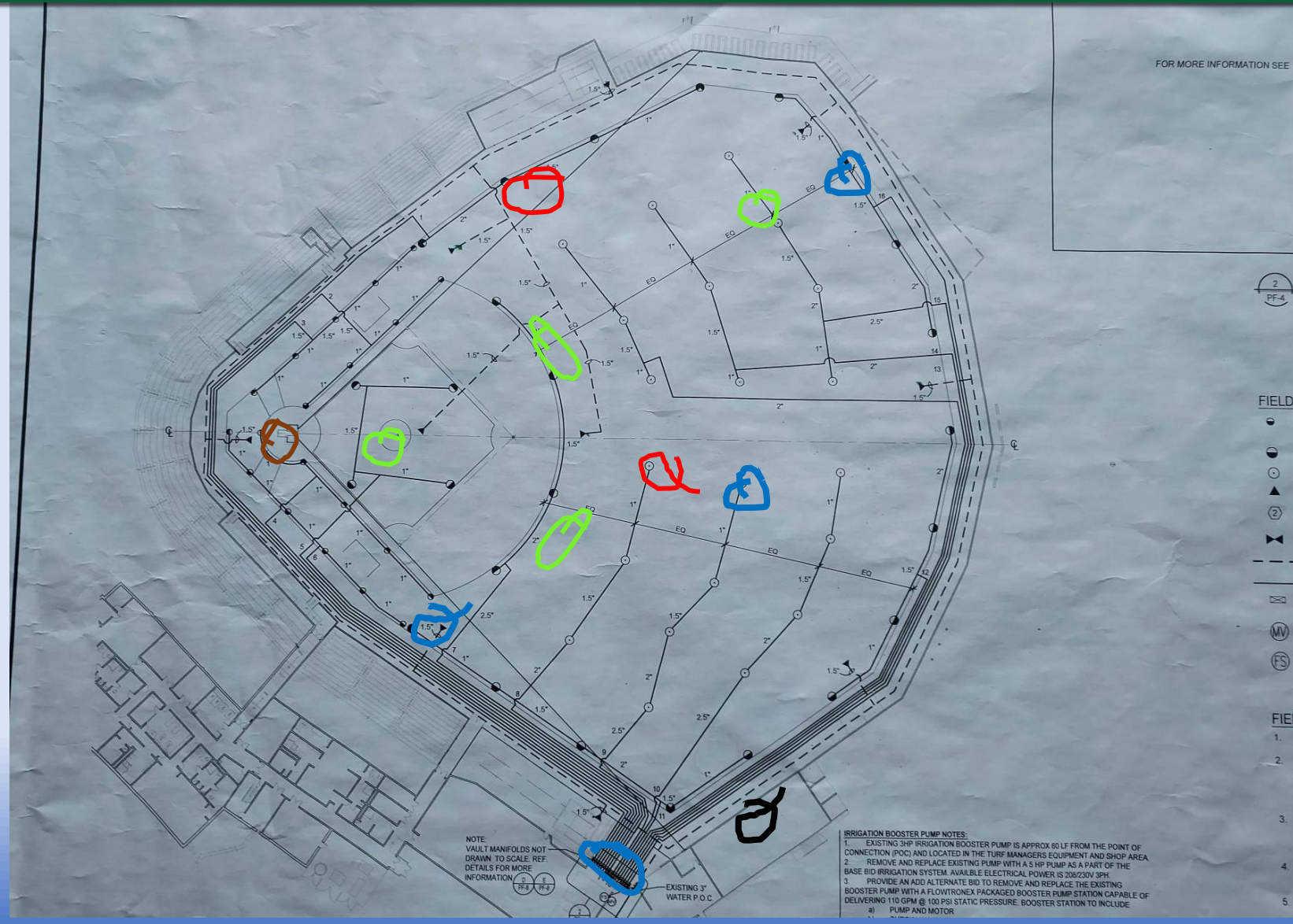
Tracking Problems



Laminate a table-sized (or any sized) diagram of an as-built system

Mount it to the break room table.

Crewmembers can indicate timely problems.



FOR MORE INFORMATION SEE

2
PF-4

FIELD

FIELD

1.

2.

3.

4.

5.

NOTE:
VAULT MANIFOLDS NOT
DRAWN TO SCALE. REF.
DETAILS FOR MORE
INFORMATION

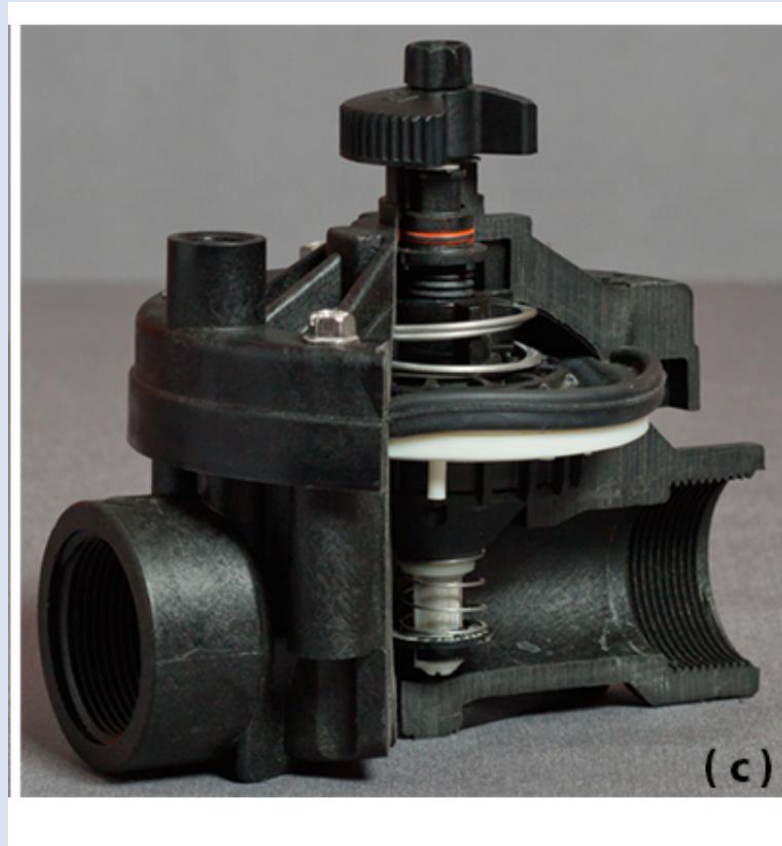
EXISTING 1"
WATER P.O.C.

IRRIGATION BOOSTER PUMP NOTES:
1. EXISTING 3HP IRRIGATION BOOSTER PUMP IS APPROX 60 LF FROM THE POINT OF CONNECTION (POC) AND LOCATED IN THE TURF MANAGERS EQUIPMENT AND SHOP AREA
2. REMOVE AND REPLACE EXISTING PUMP WITH A 5 HP PUMP AS A PART OF THE BASE BID IRRIGATION SYSTEM. AVAILABLE ELECTRICAL POWER IS 208/230V 3PH
3. PROVIDE AN ADD ALTERNATE BID TO REMOVE AND REPLACE THE EXISTING BOOSTER PUMP WITH A FLOWTRONEX PACKAGED BOOSTER PUMP STATION CAPABLE OF DELIVERING 110 GPM @ 100 PSI STATIC PRESSURE. BOOSTER STATION TO INCLUDE PUMP AND MOTOR

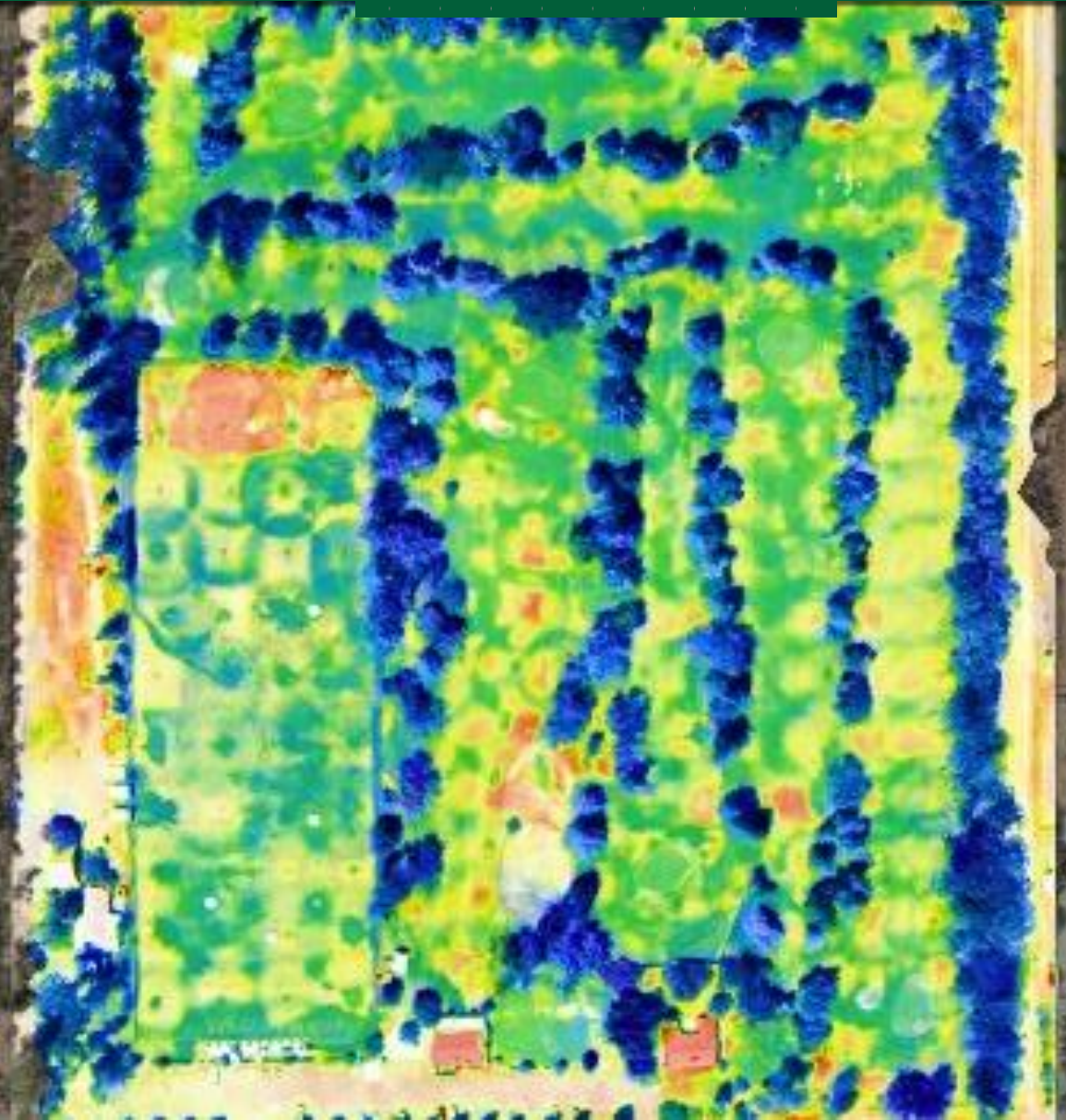
Learn Your Inventory!



Learn Your System and Sprinklers



Use Technology for Perspective

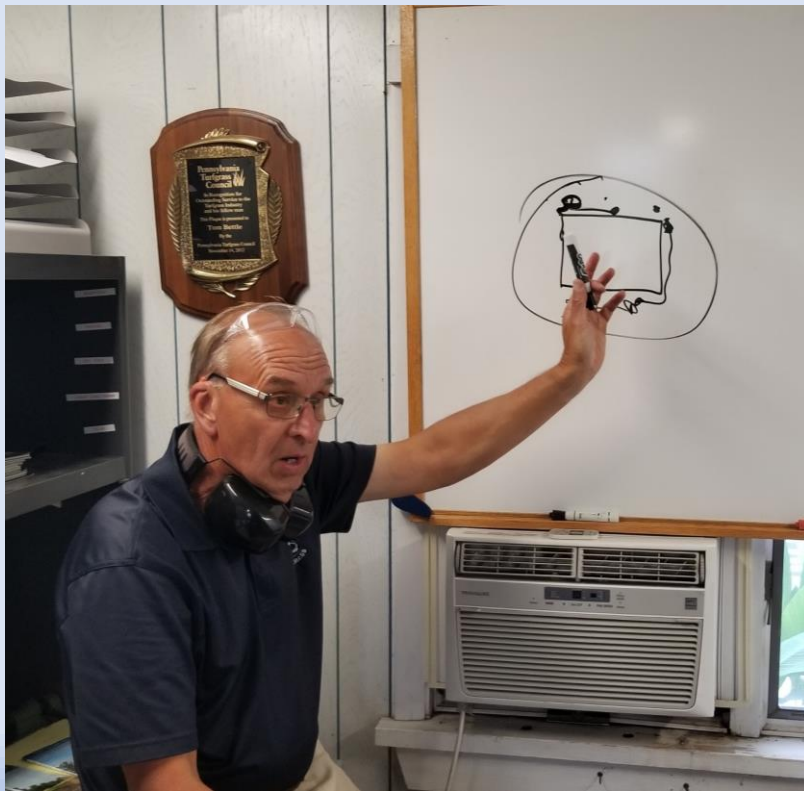




Simplify the Process



Before launching a thorough system diagnosis, check the obvious



Let's Troubleshoot!



Examples

1. Sprinklers WILL NOT Turn ON
2. Low Pressure
3. Sprinklers WILL NOT Turn OFF or Valve Seeps

Sprinkler WILL NOT Turn ON

Process of Elimination:

Find out what it isn't

Check the Obvious

- Do I have water? Power?

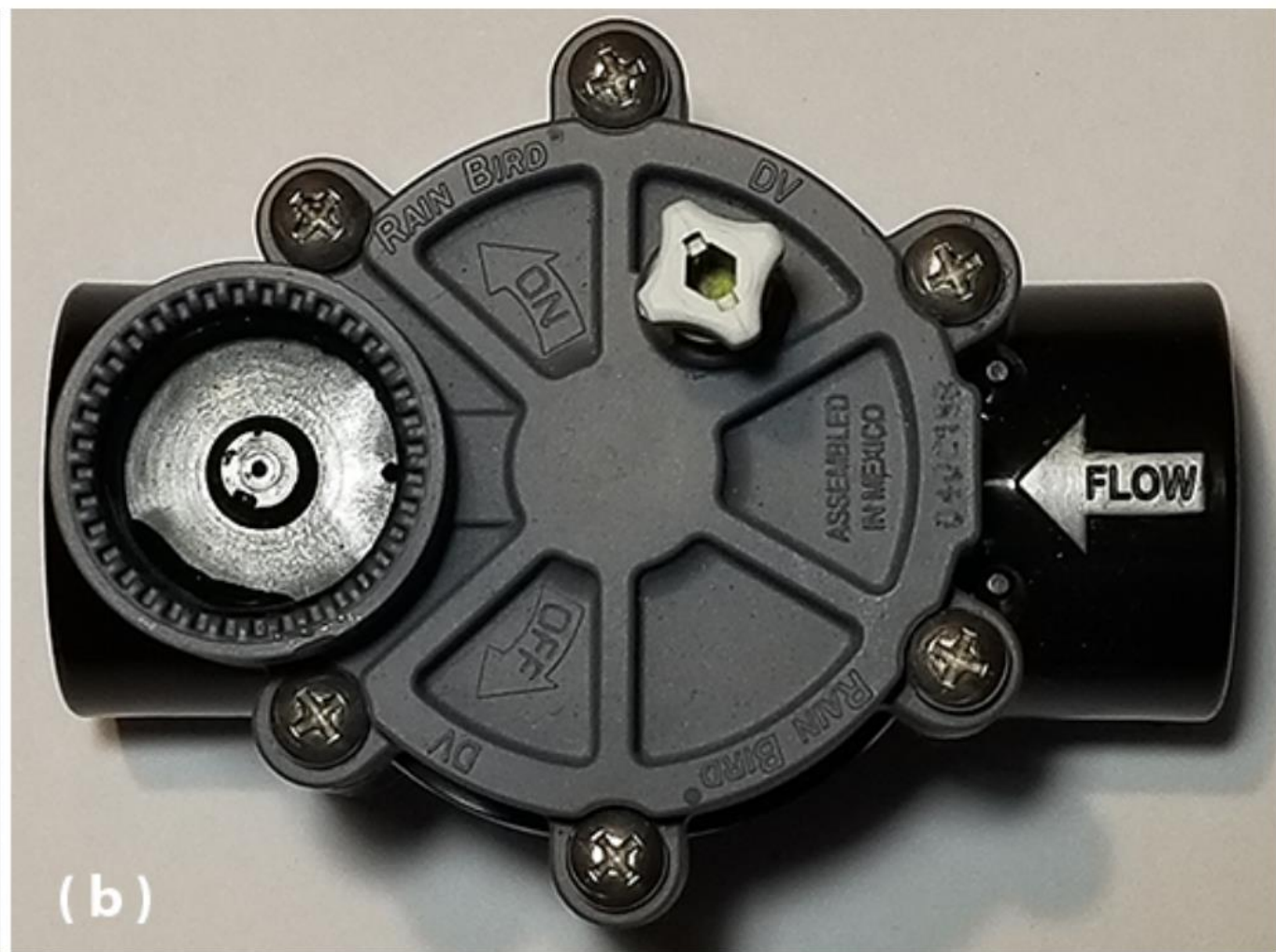


Let's Troubleshoot!



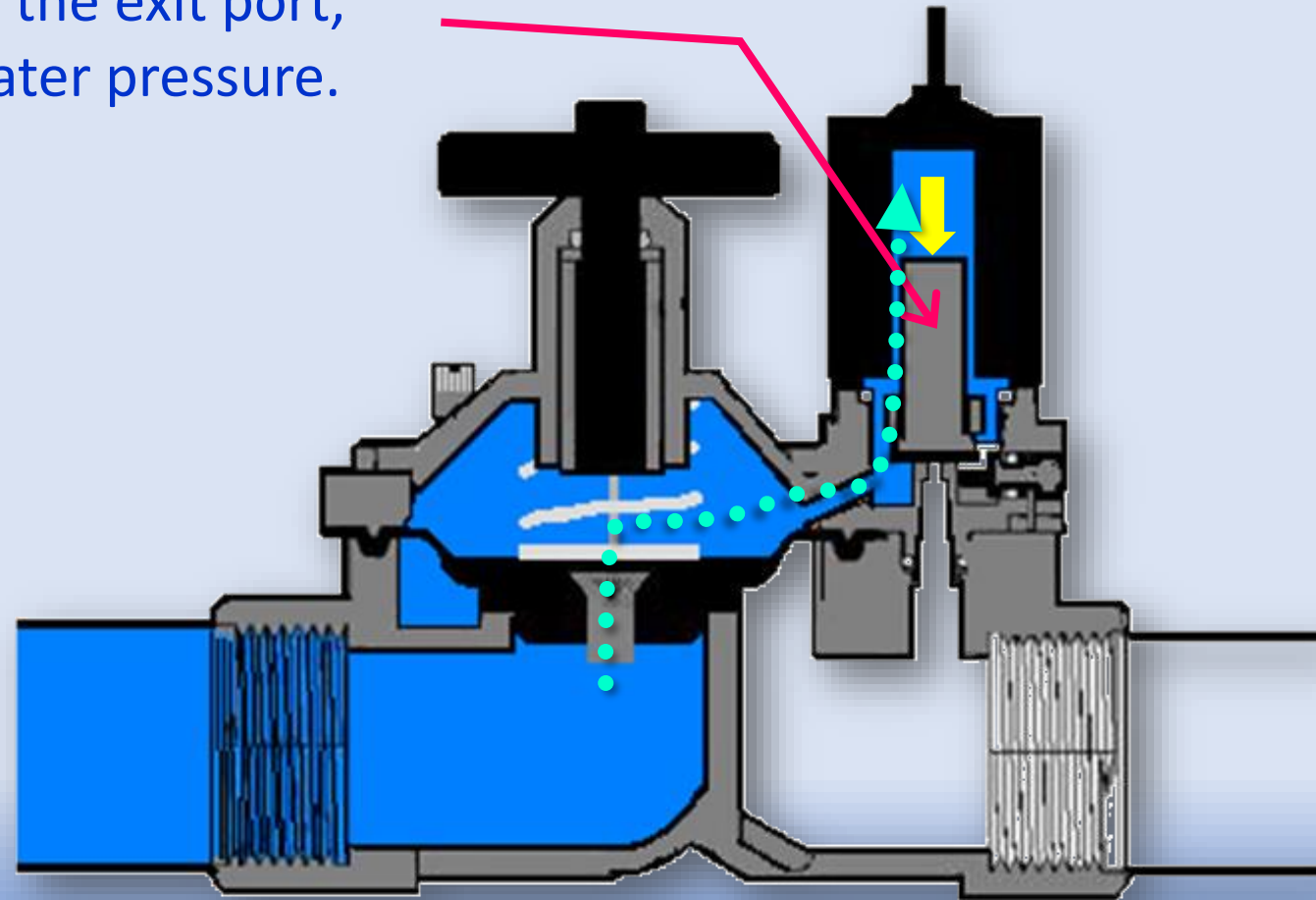
Quick Valve Review

1. 24 volt signal to the solenoid
2. Solenoid retracts plunger
3. Water from on top of the diaphragm flows out through the exit port
4. Diaphragm is lifted off of seat
5. Water flows over diaphragm seat and out of valve



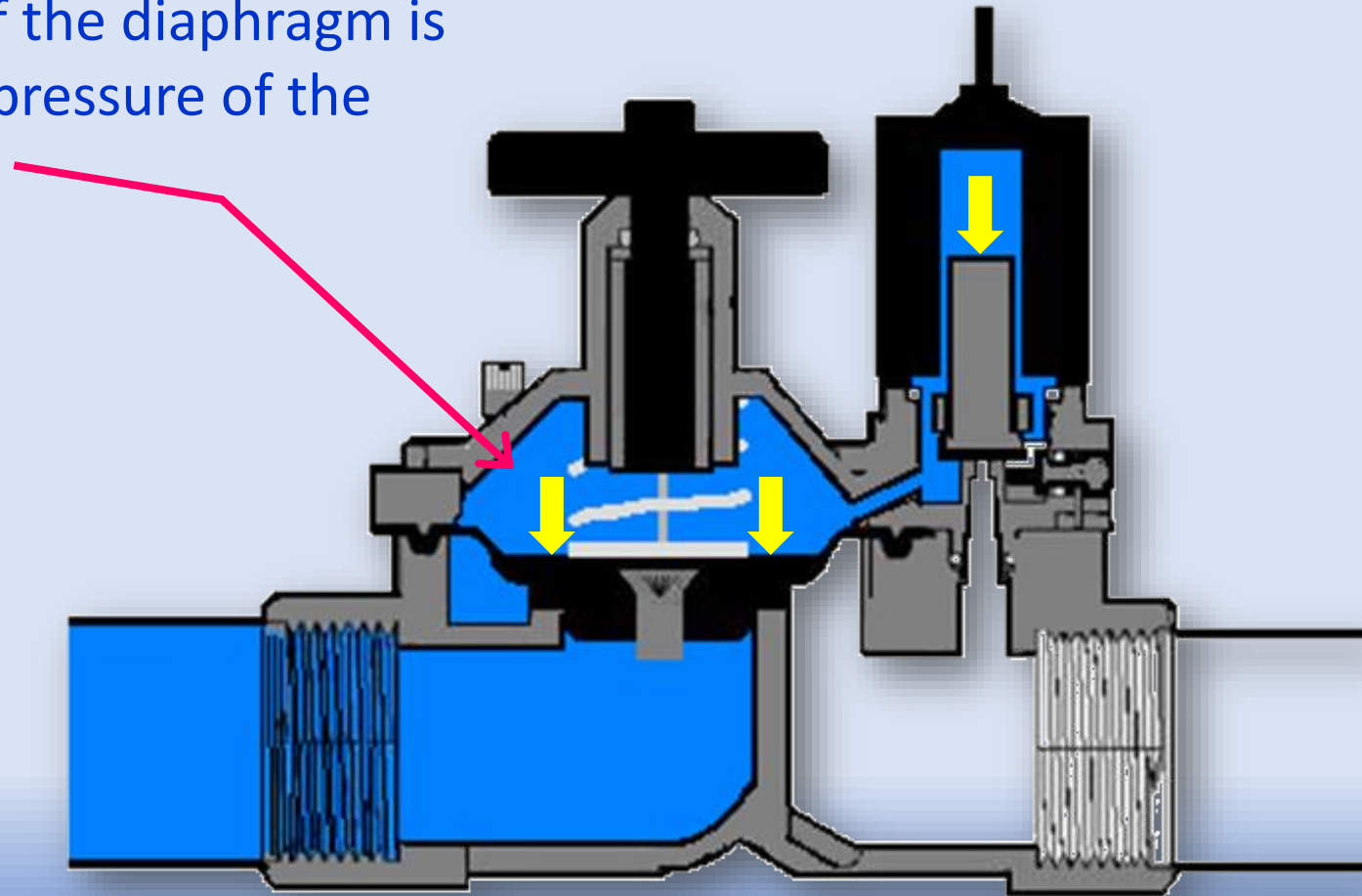
Forward-Flow Valve Closed

The plunger is seated over the exit port, held down by the static water pressure.



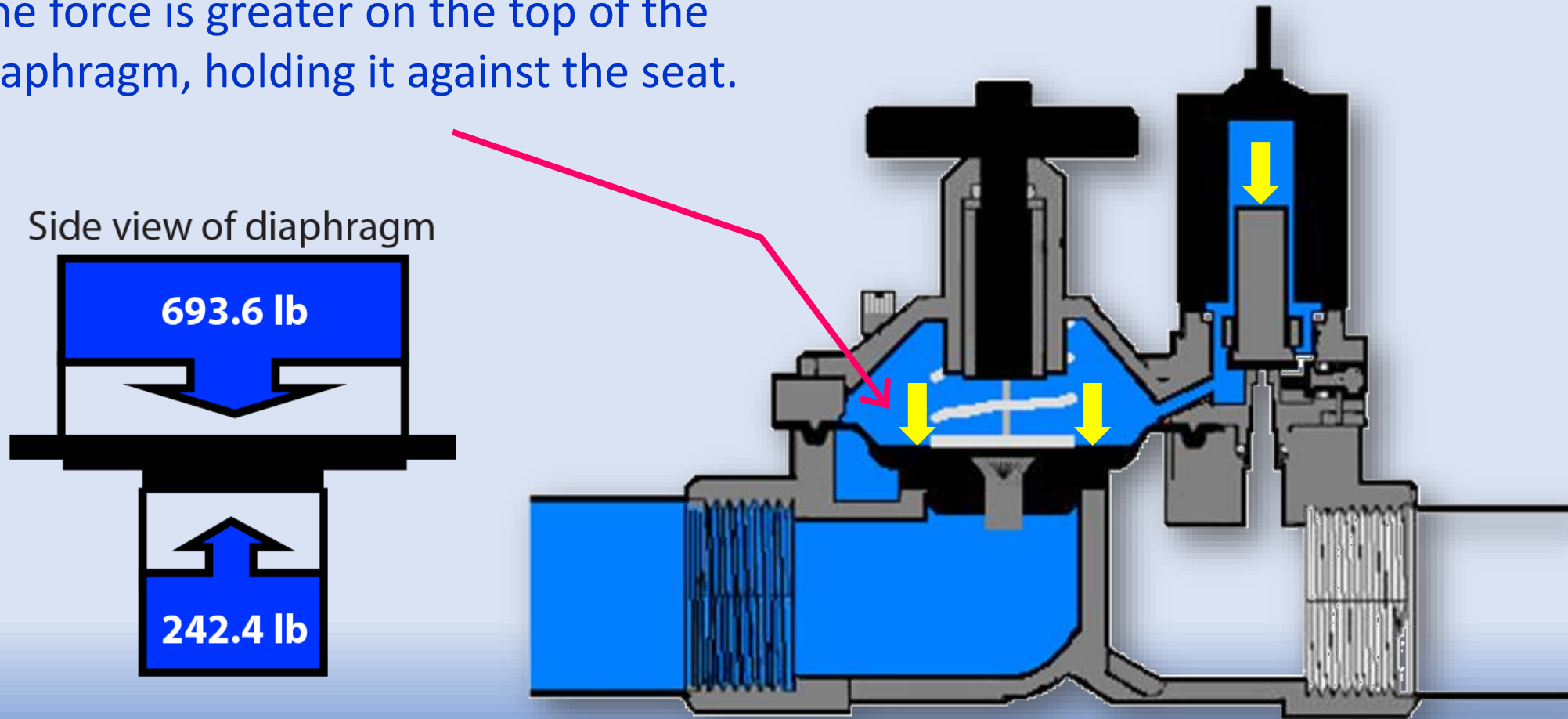
Forward-Flow Valve Closed

The bonnet area on top of the diaphragm is full of water and at static pressure of the system.



Forward-Flow Valve Closed

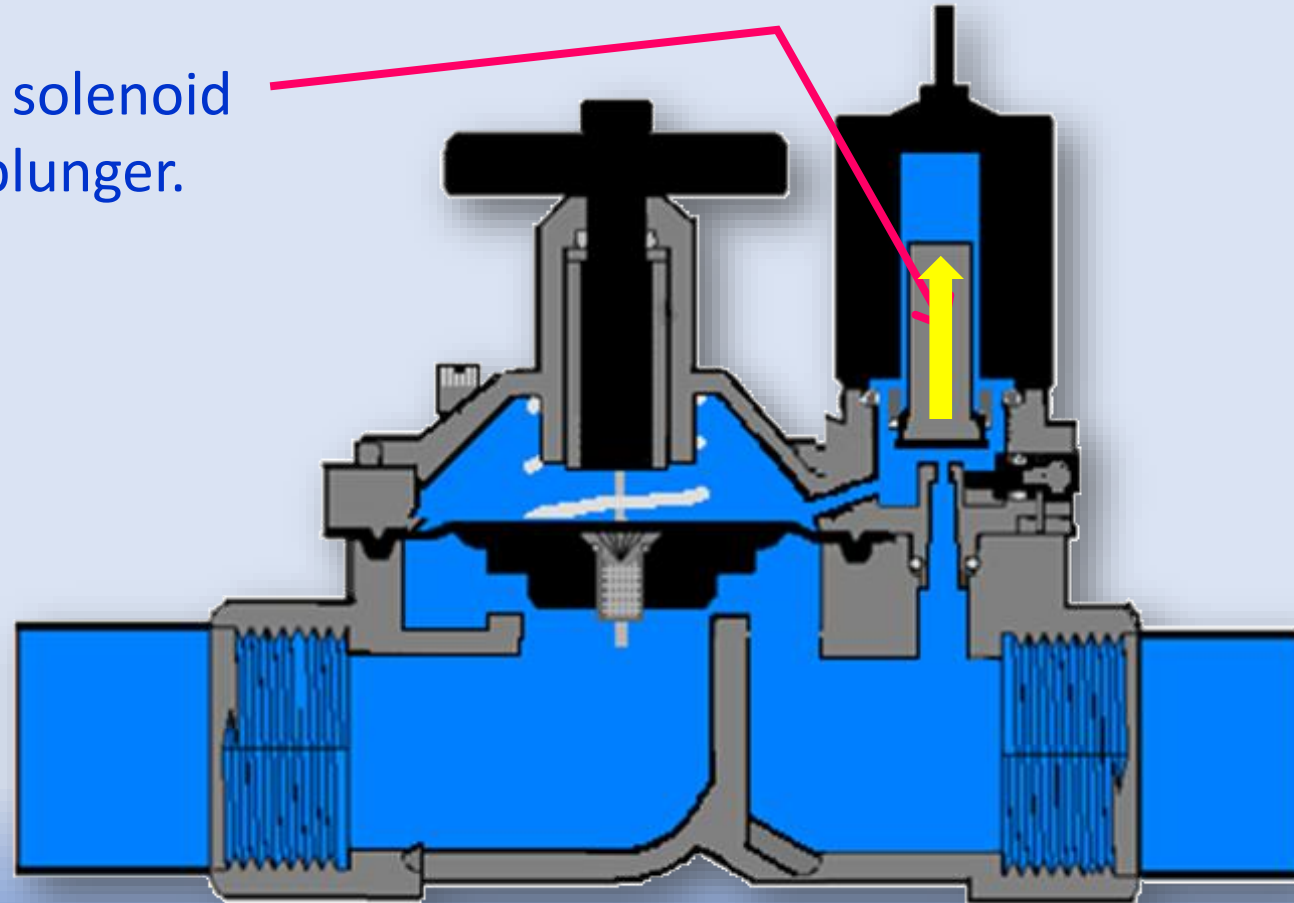
The force is greater on the top of the diaphragm, holding it against the seat.



How a Forward-Flow Valve Opens

1.

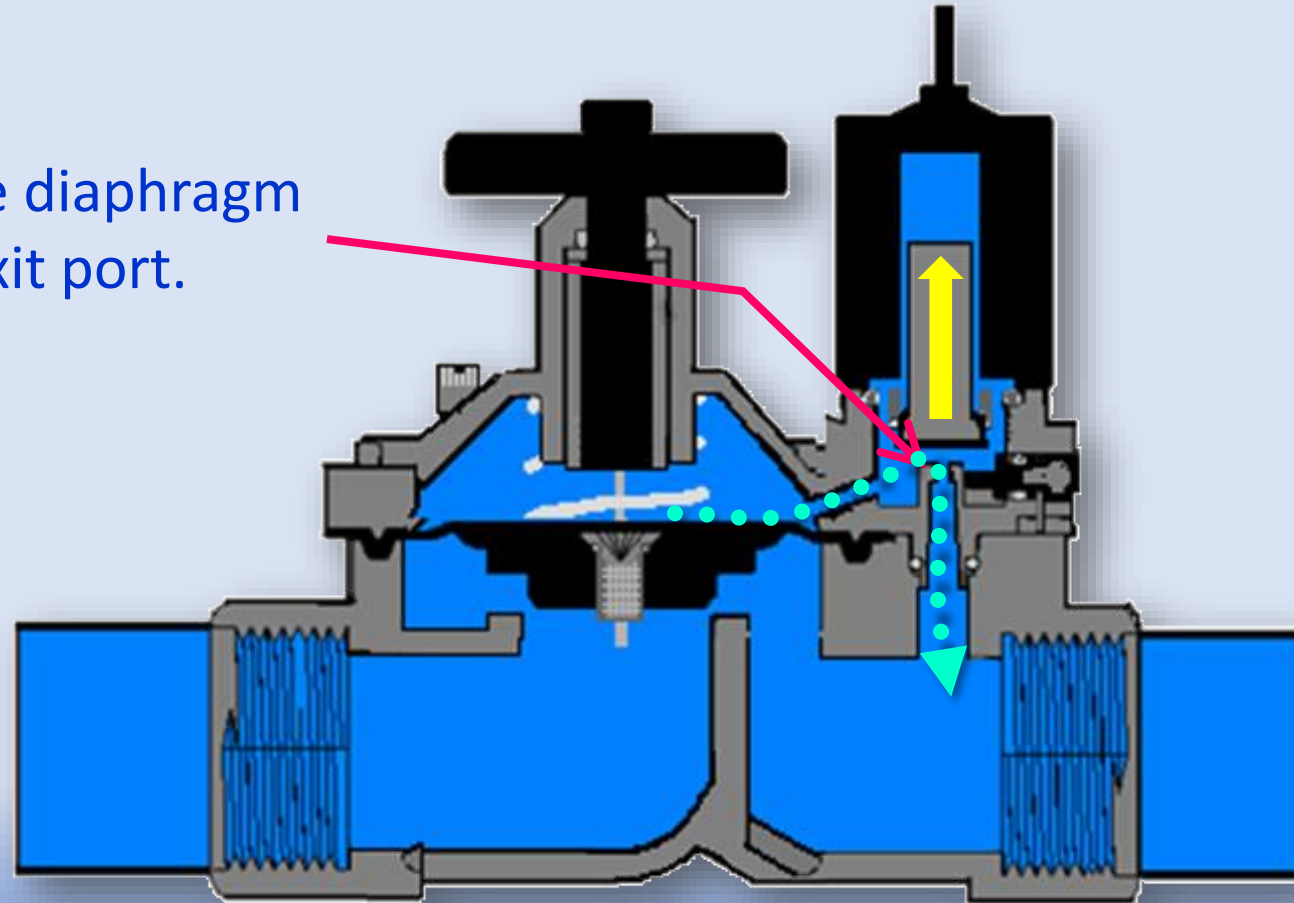
The controller energizes the solenoid and lifts and holds up the plunger.



How a Forward-Flow Valve Opens

2.

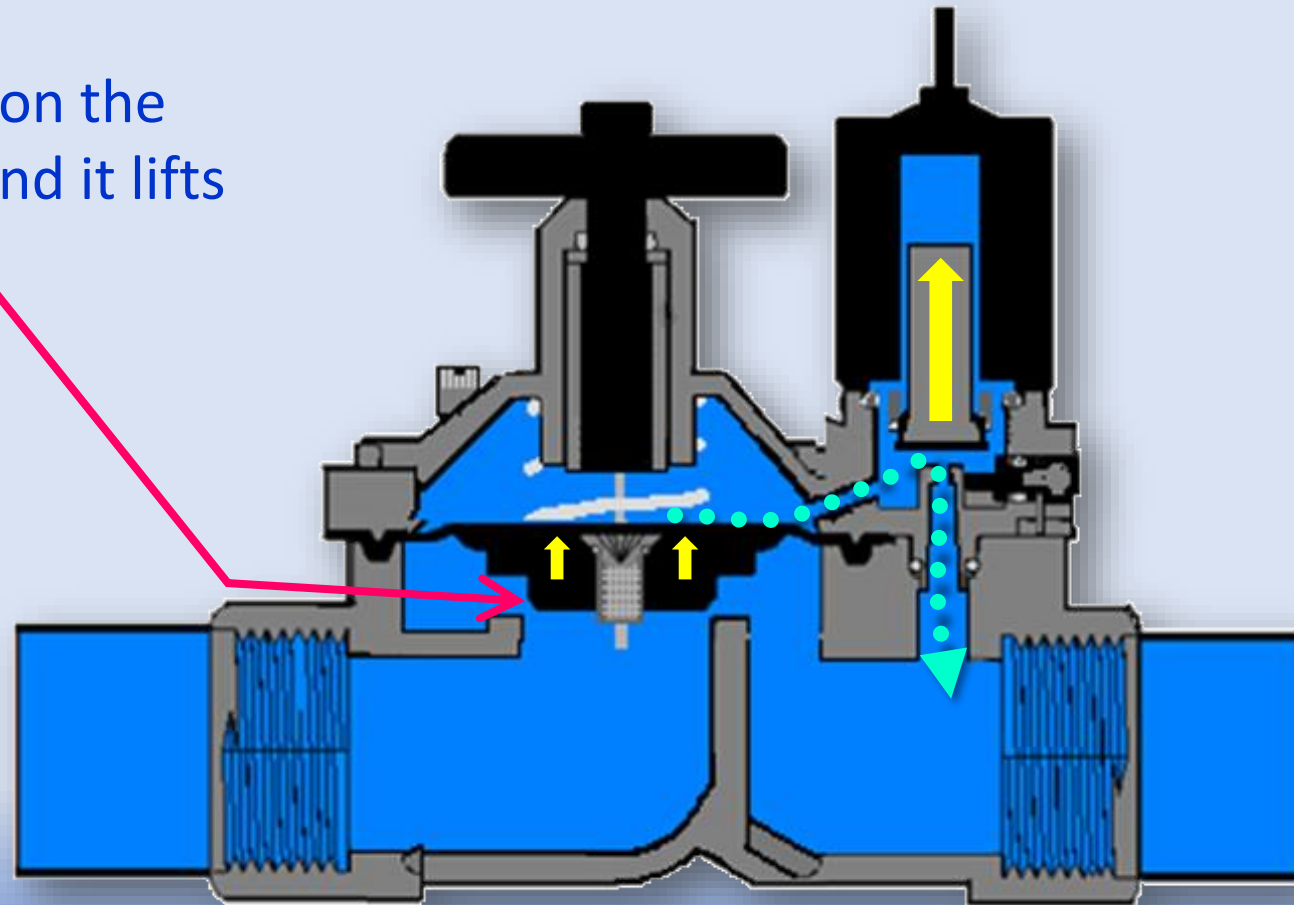
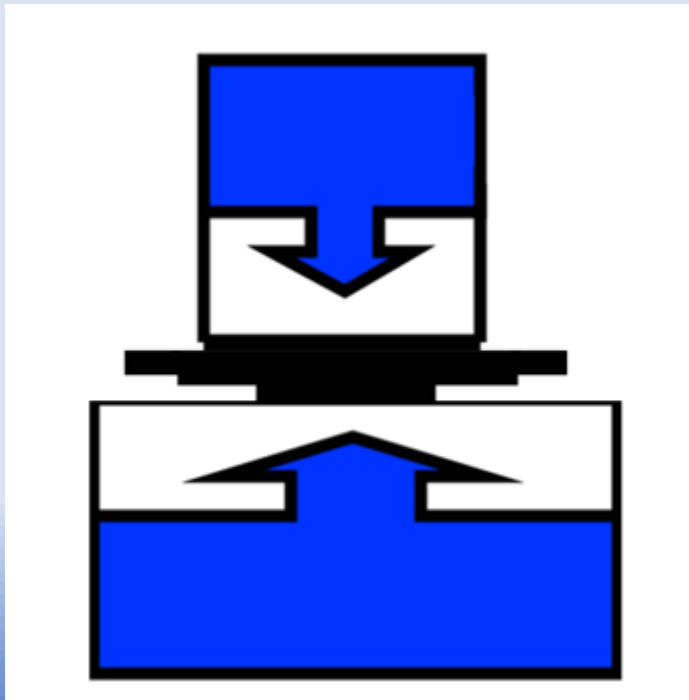
The water from on top of the diaphragm flows out through the exit port.



How a Forward-Flow Valve Opens

3.

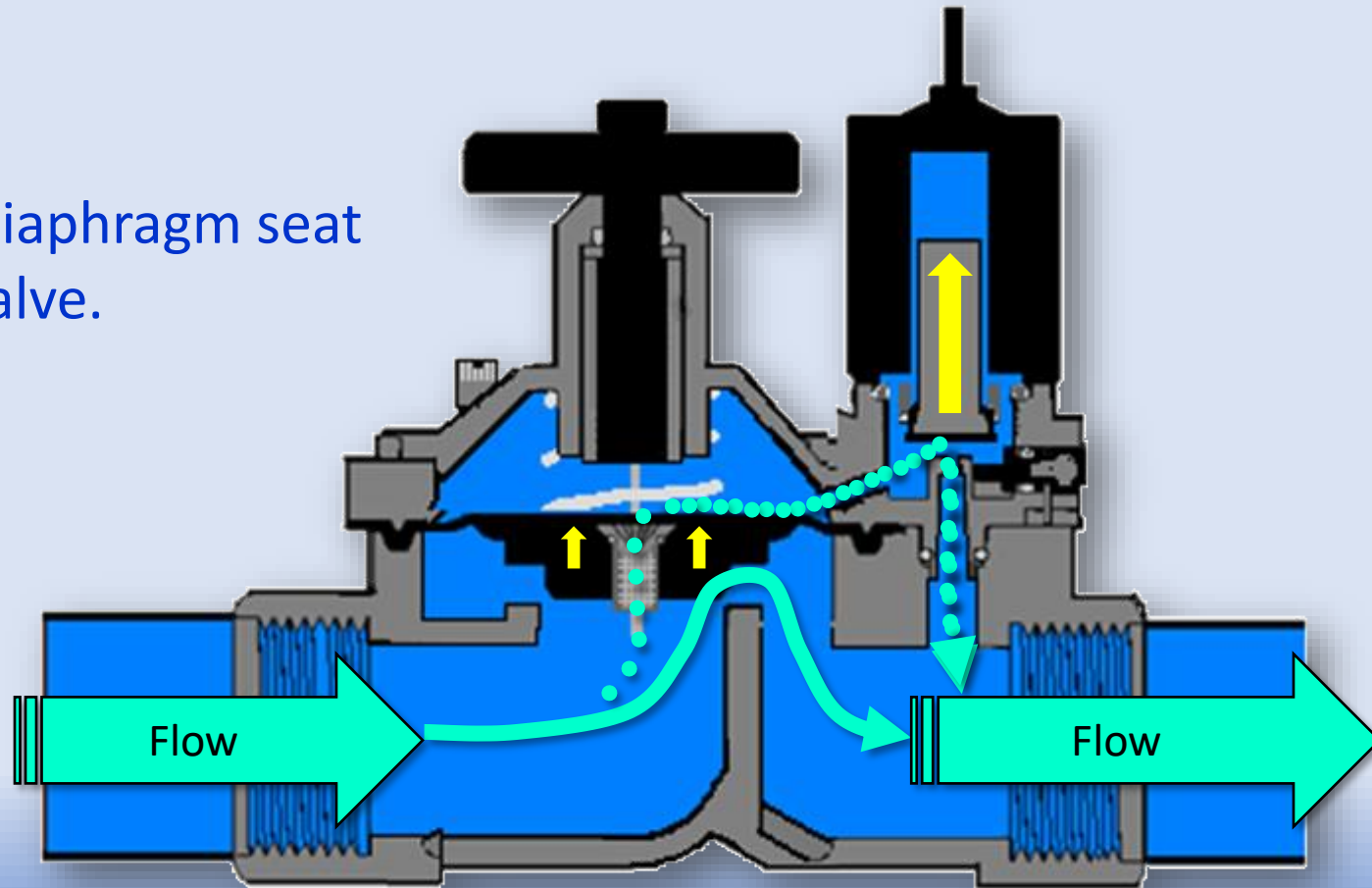
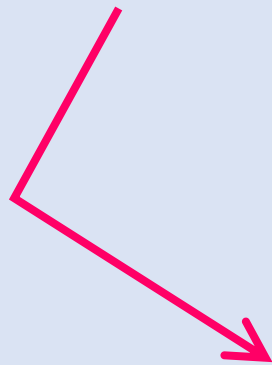
The force is now greater on the bottom of the diaphragm and it lifts off the seat.



How a Forward-Flow Valve Opens

4.

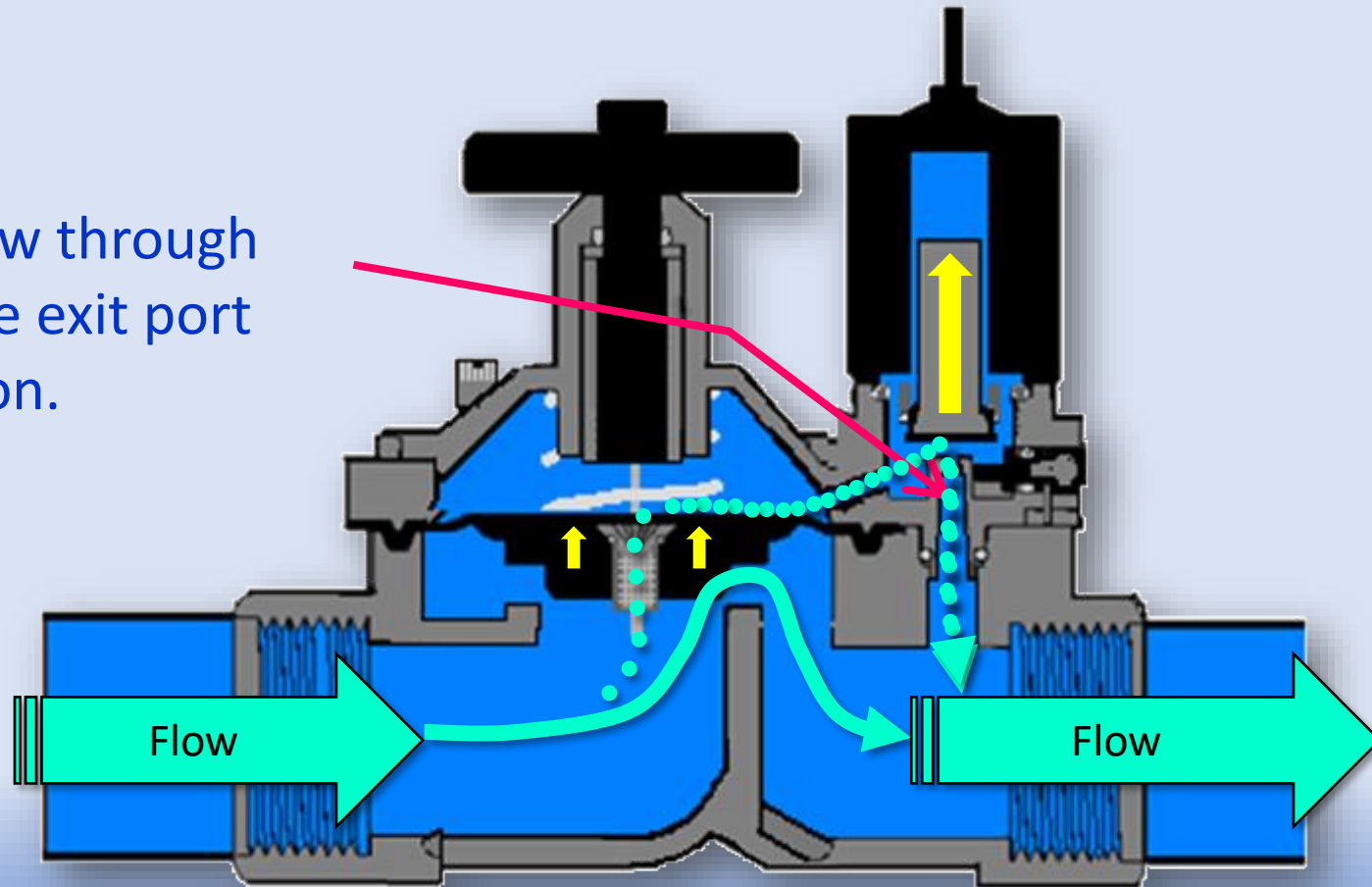
The water flows over the diaphragm seat and out of the valve.



How a Forward-Flow Valve Opens

5.

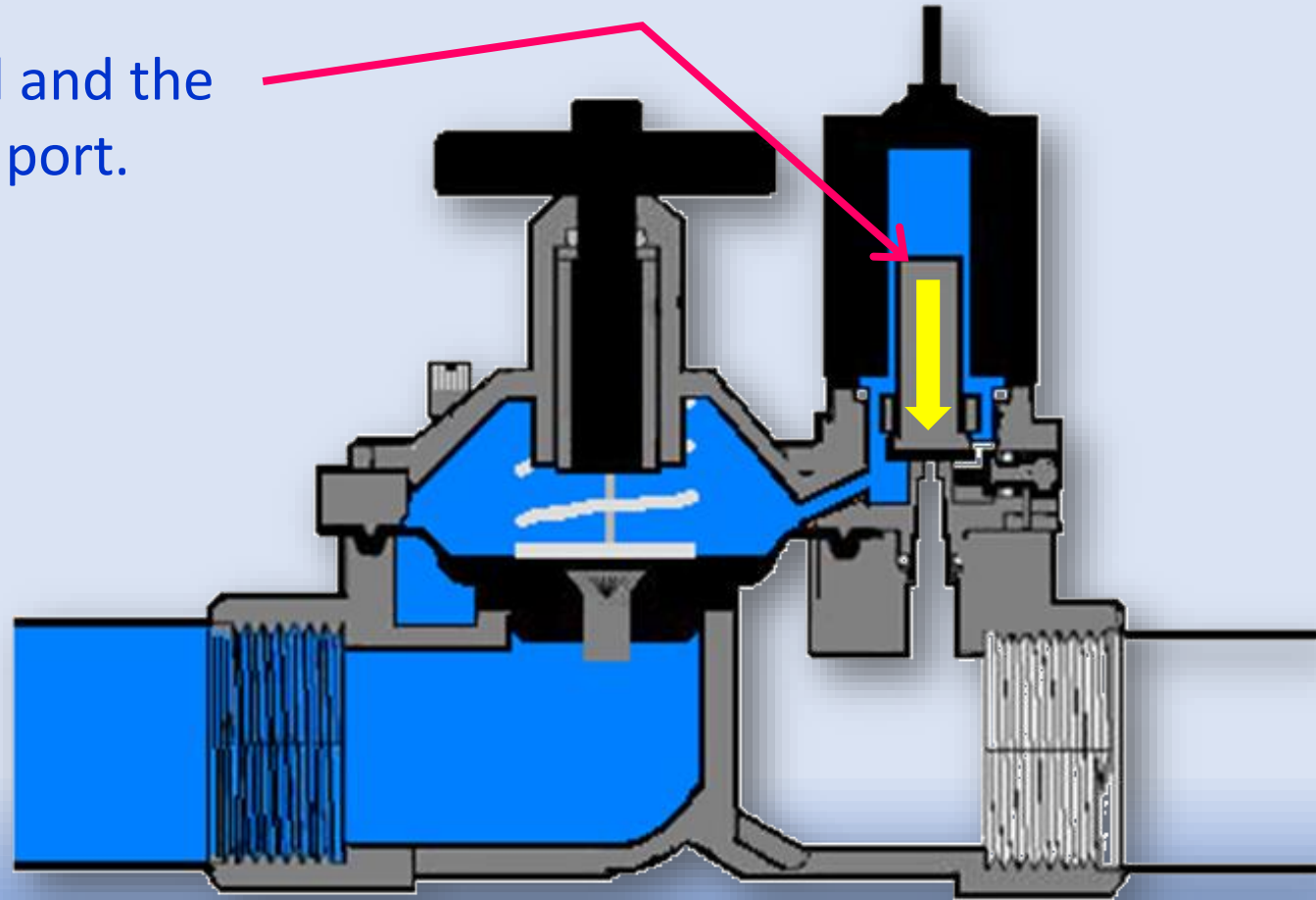
The water continues to flow through the diaphragm and out the exit port while the valve is on.



How a Forward-Flow Valve Closes

1.

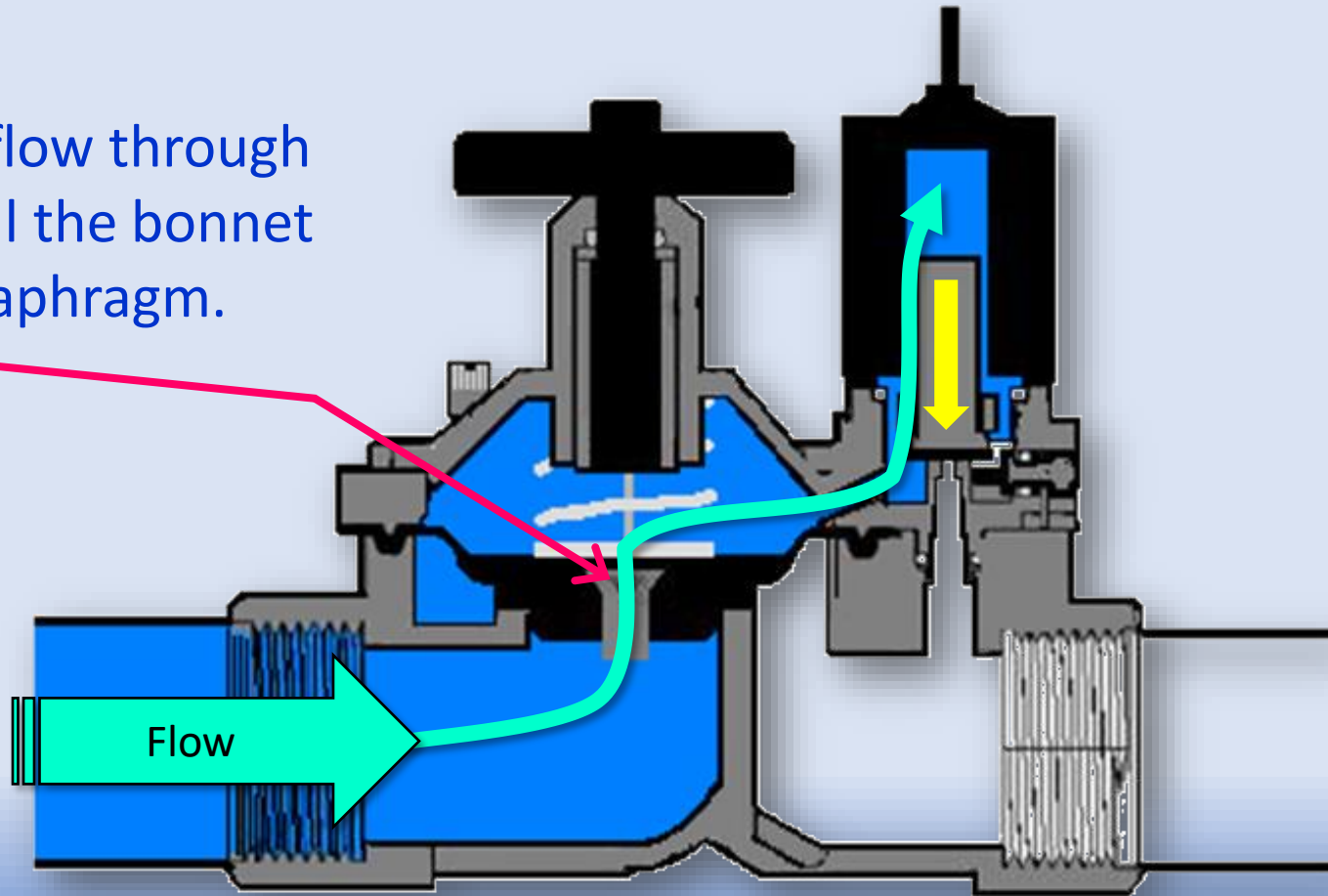
The solenoid is de-energized and the plunger seats on the exit port.



How a Forward-Flow Valve Closes

2.

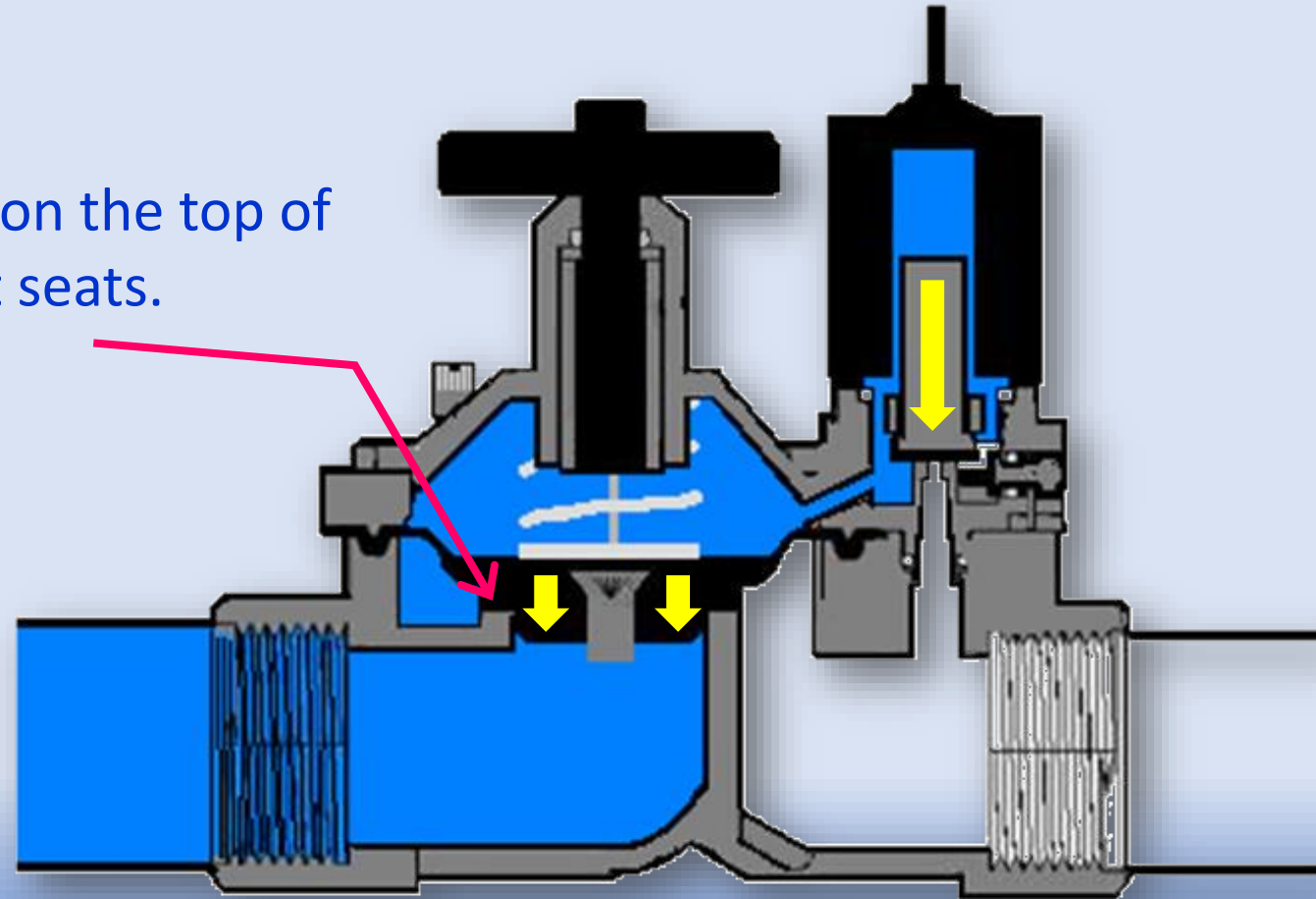
The water continues to flow through the diaphragm port to fill the bonnet area on top of the diaphragm.



How a Forward-Flow Valve Closes

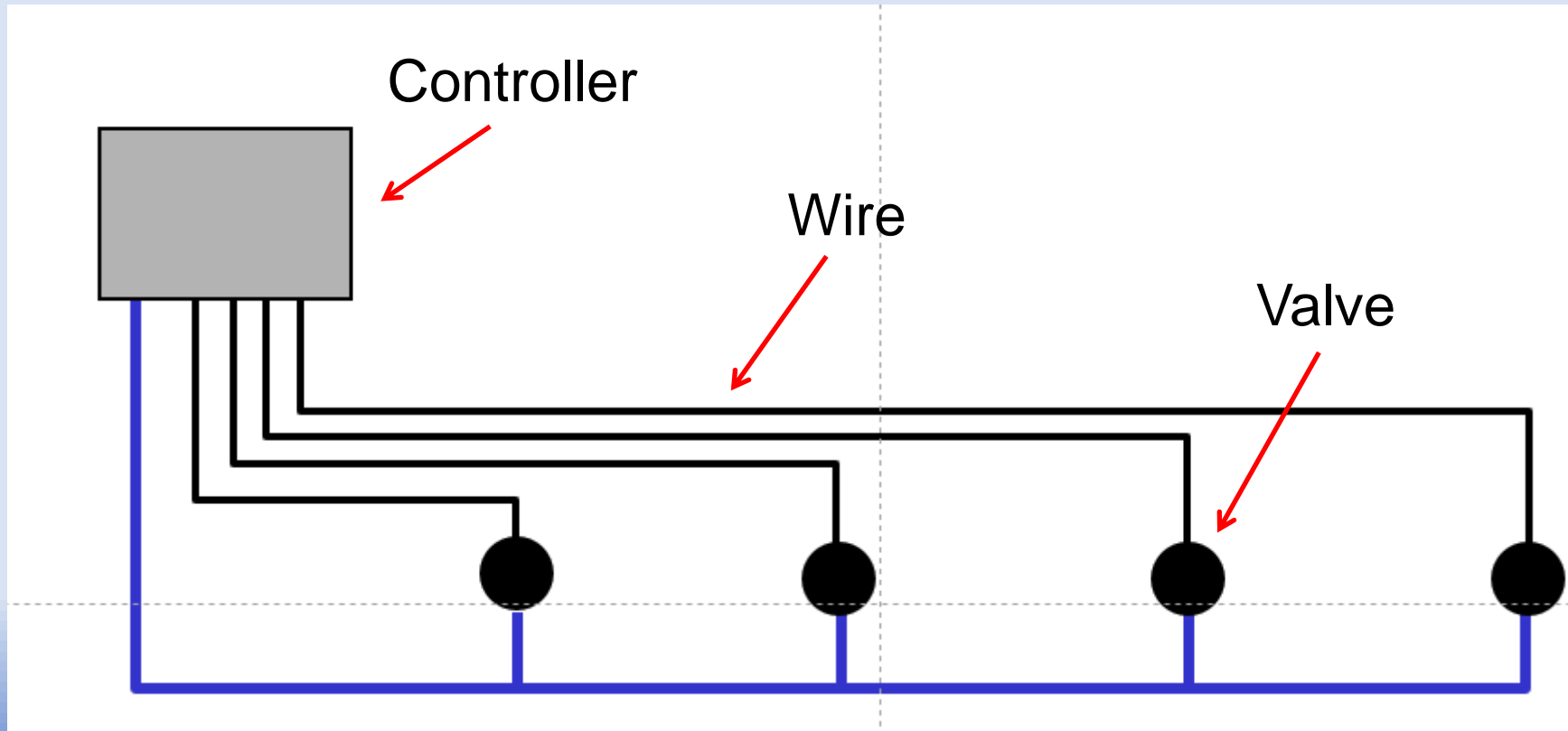
3.

The force becomes greater on the top of the diaphragm and it seats.



Troubleshooting

- Steps 1 and 2 deal with the electronics
- There are only three electrical components to be considered while troubleshooting.
- Below is a list of electrical components in the order of their importance:



Troubleshooting the controller

Power In / Power Out

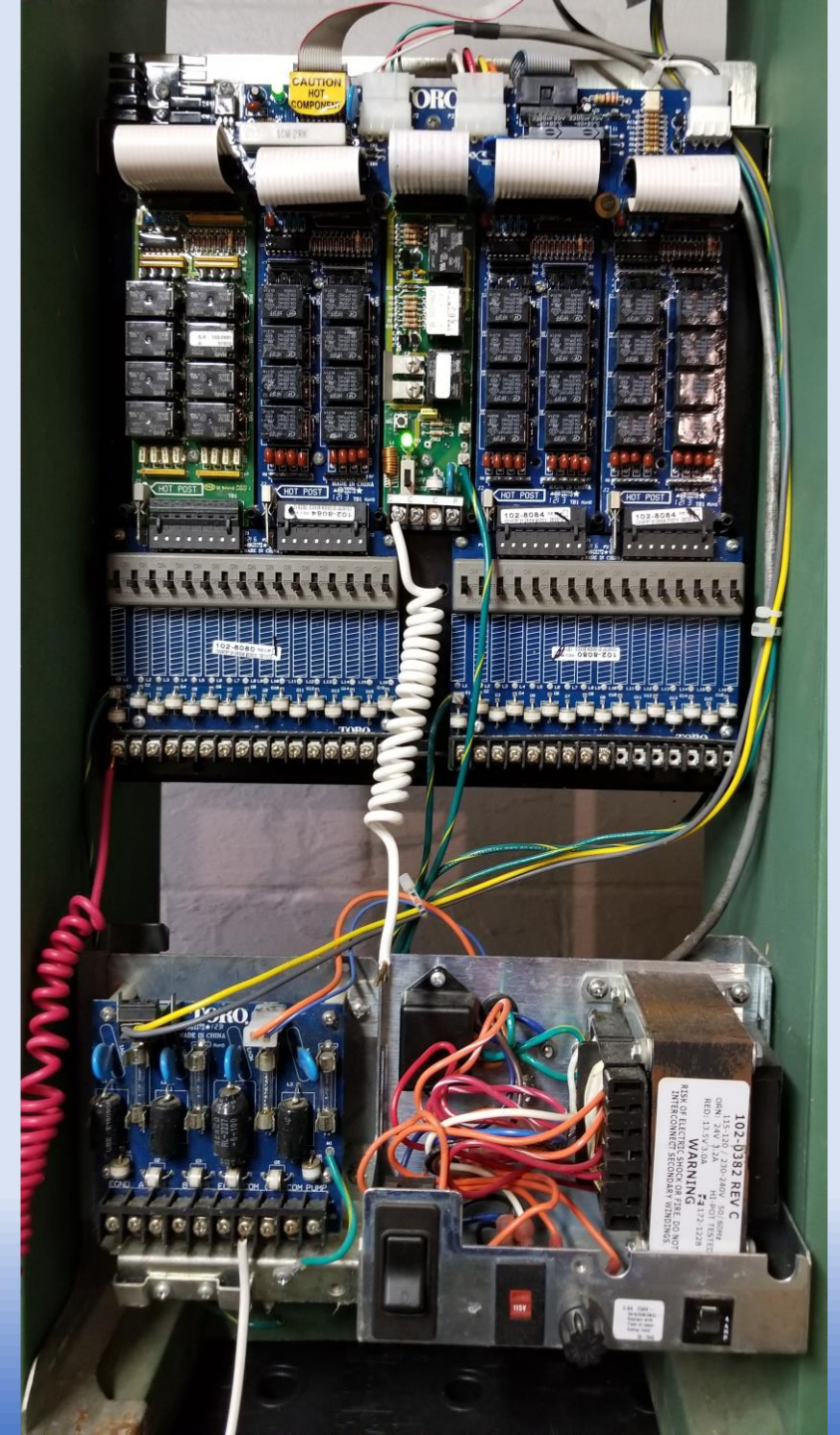
- How many volts input? **115VAC?**
- How many volts for station output? **24VAC?**

Program

- Is there a **START TIME**?
- Are there **WATER DAYS** activated?
- Is there **STATION RUN TIME**?

Sensors

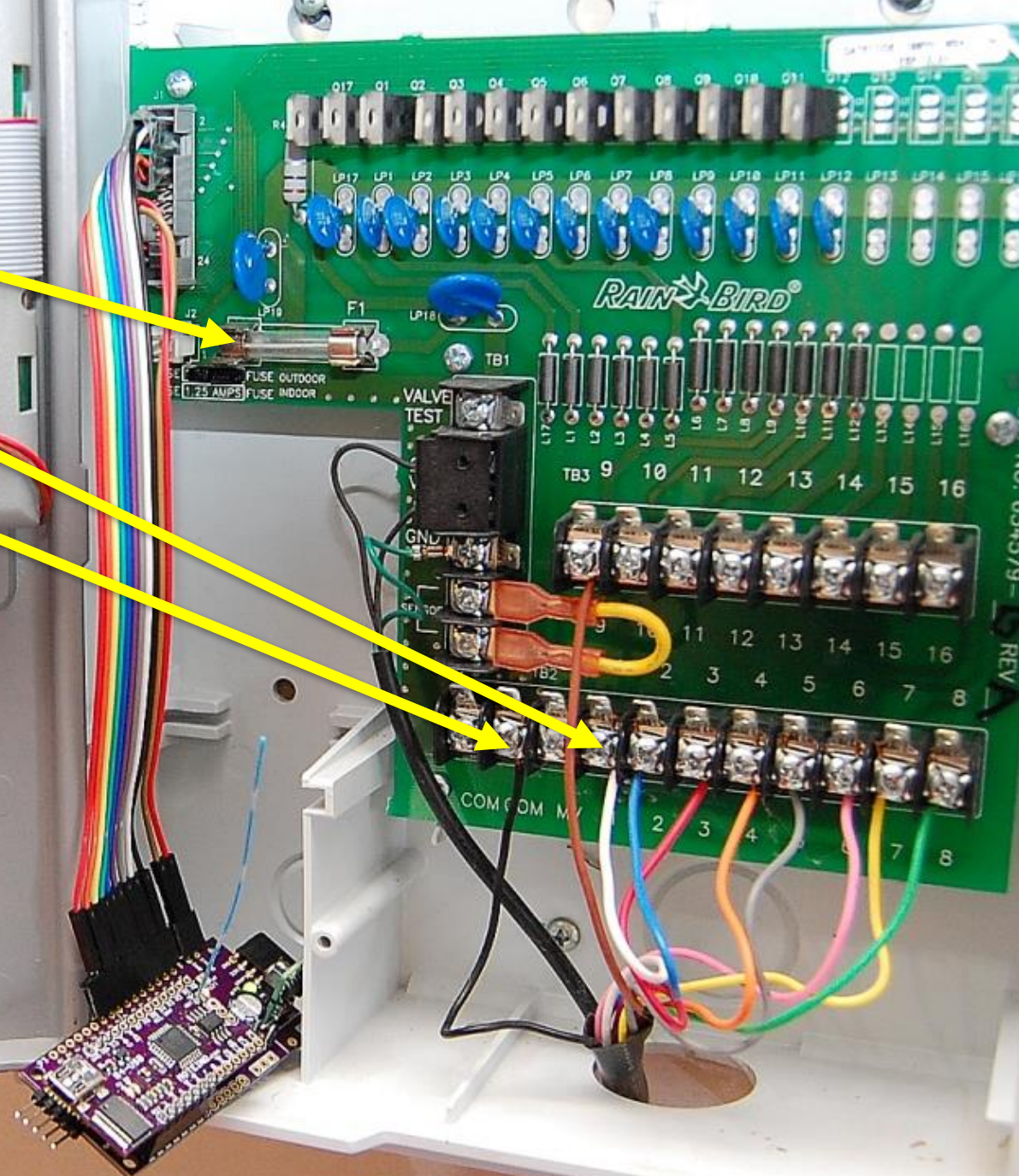
- RAIN
- MOISTURE



Check fuses!!

Turn station on then check the common and the station being tested

Be aware of wire colors!!



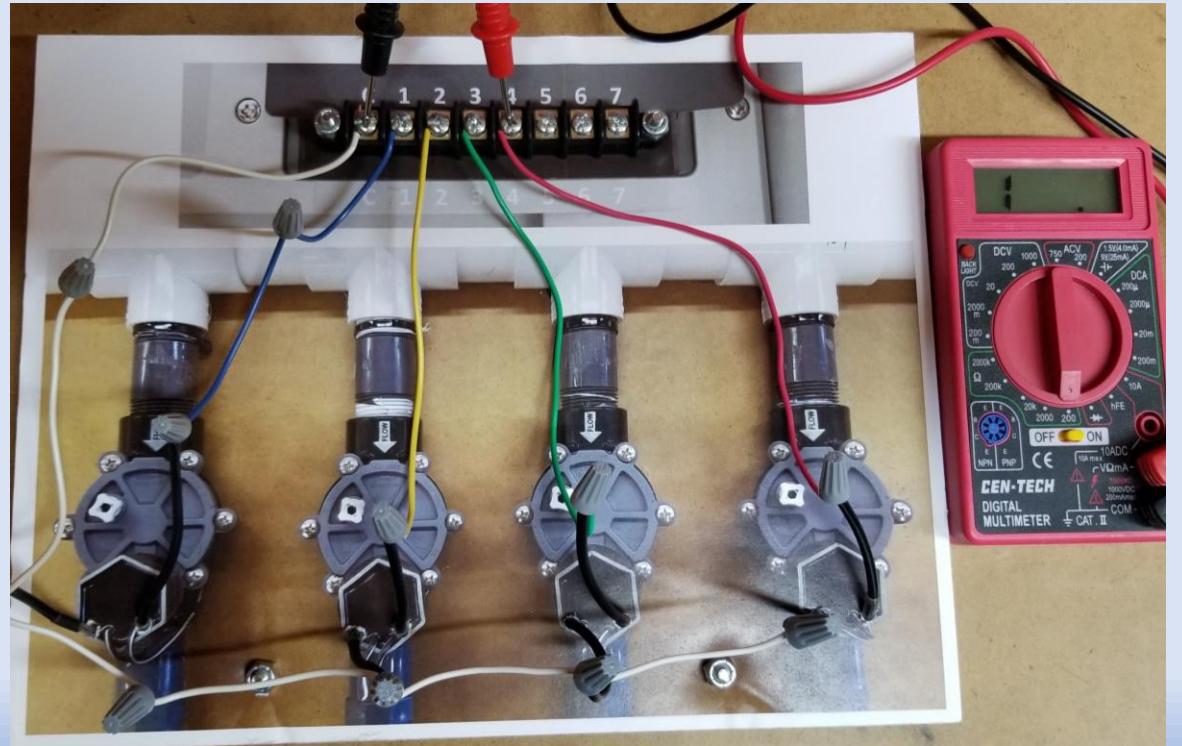
Troubleshooting Field Wiring

The Wire – What to check:

- Perform an ***Ohm*** measurement of the circuit.
- What is the normal reading?

Faults

- What are the readings for
 - Open
 - Short
 - Partial

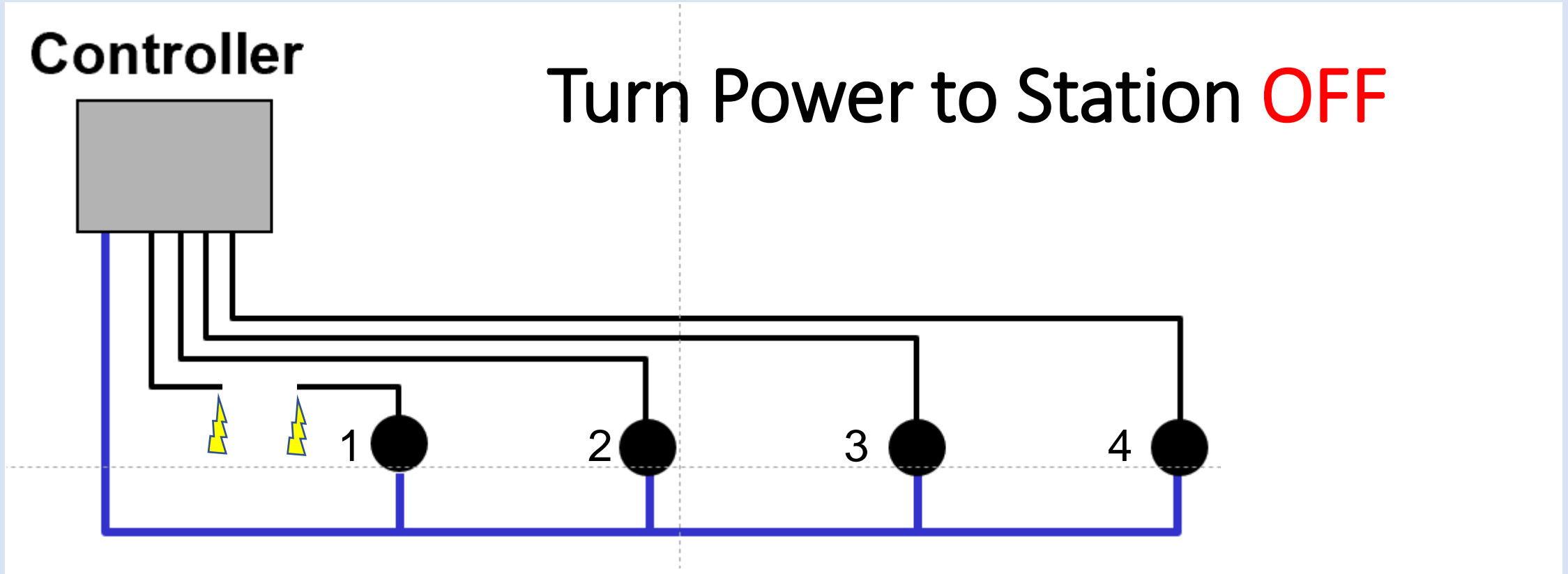


Hot (Station) Wire Open

Hot (Station) Wire Open

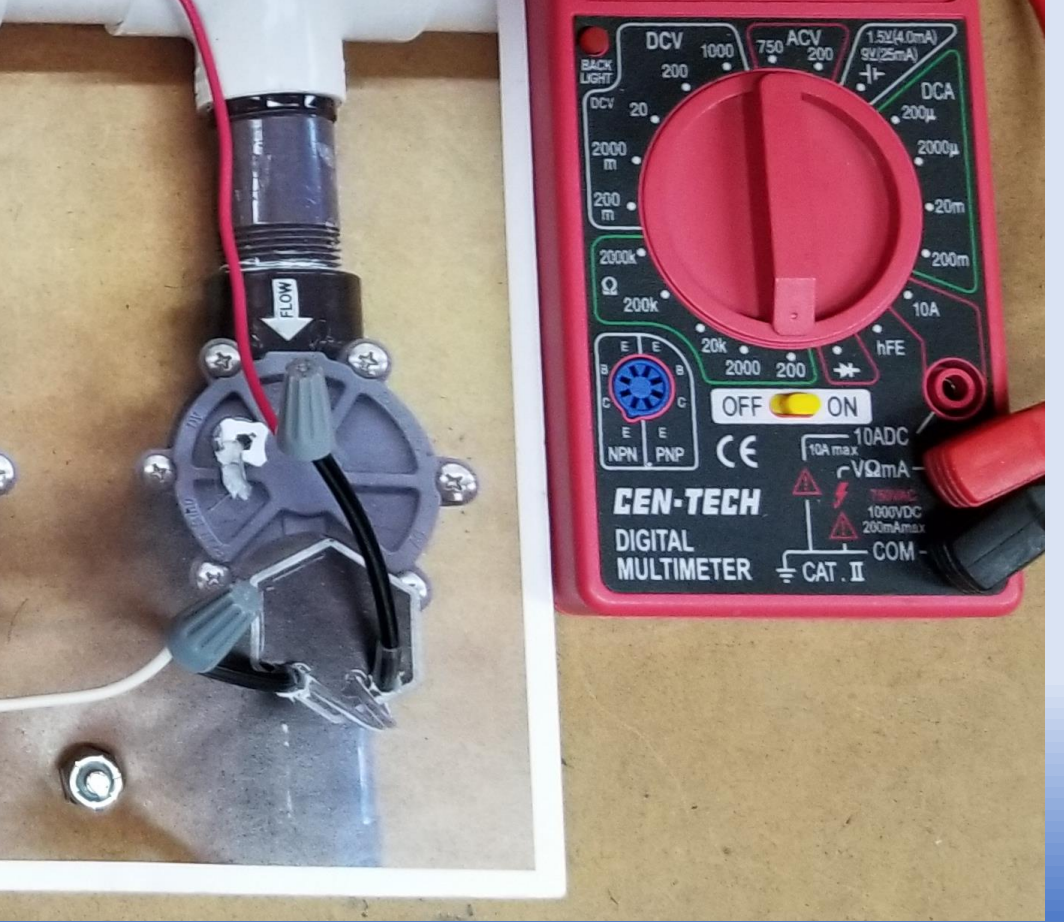
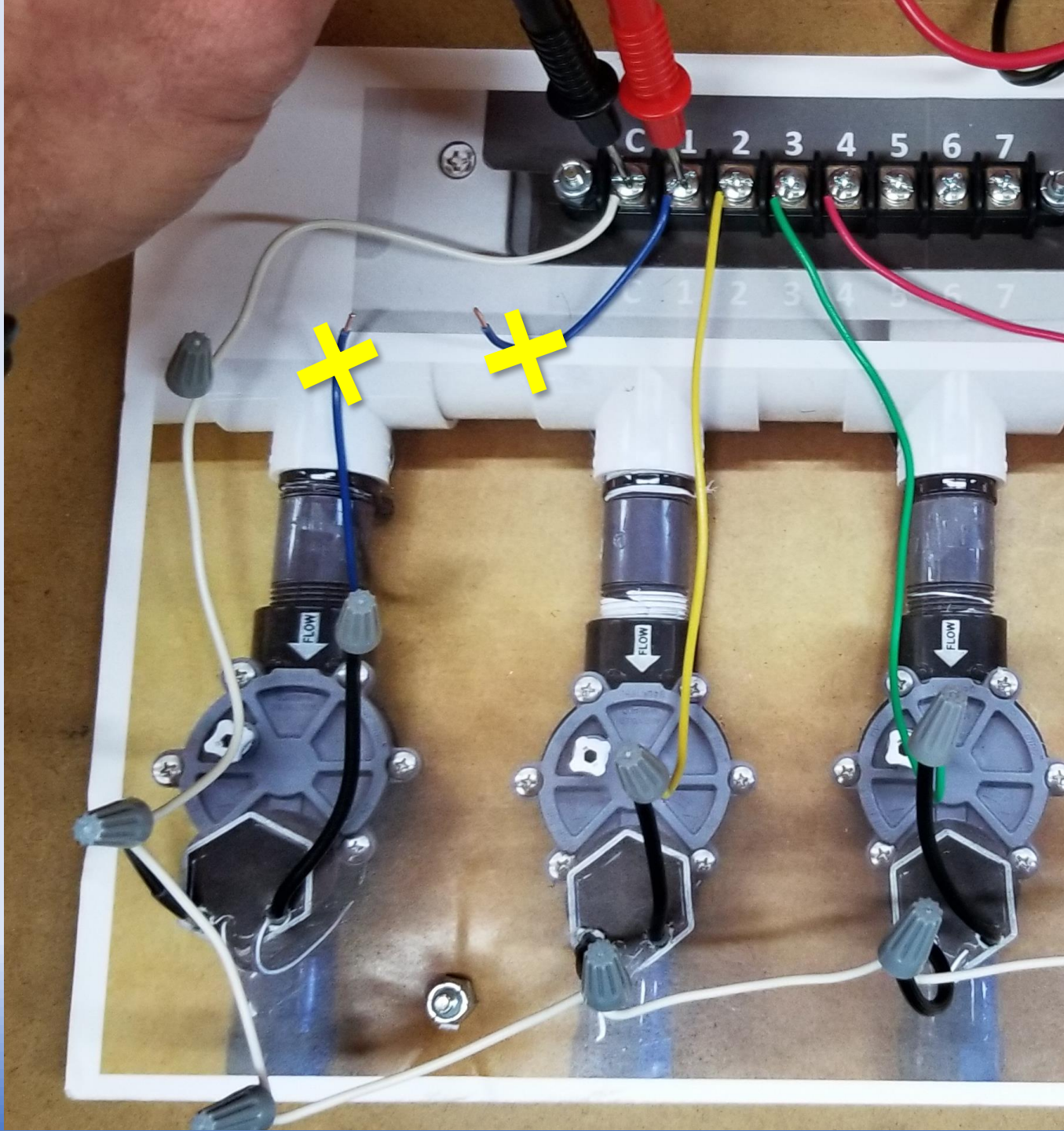
Controller

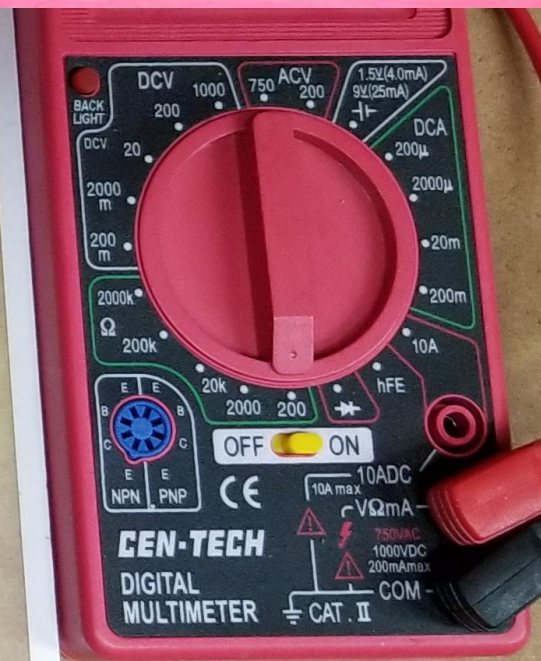
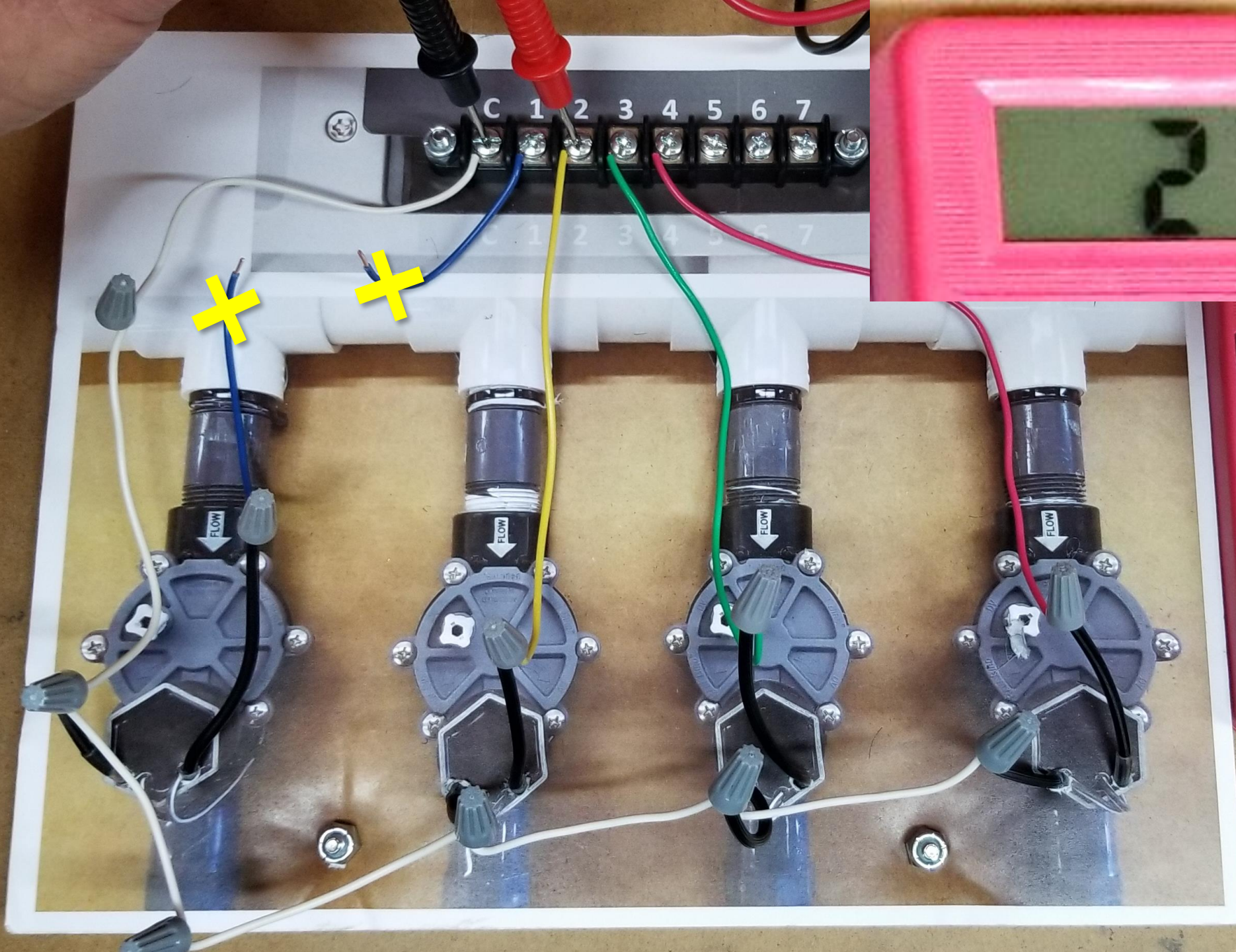
Turn Power to Station **OFF**

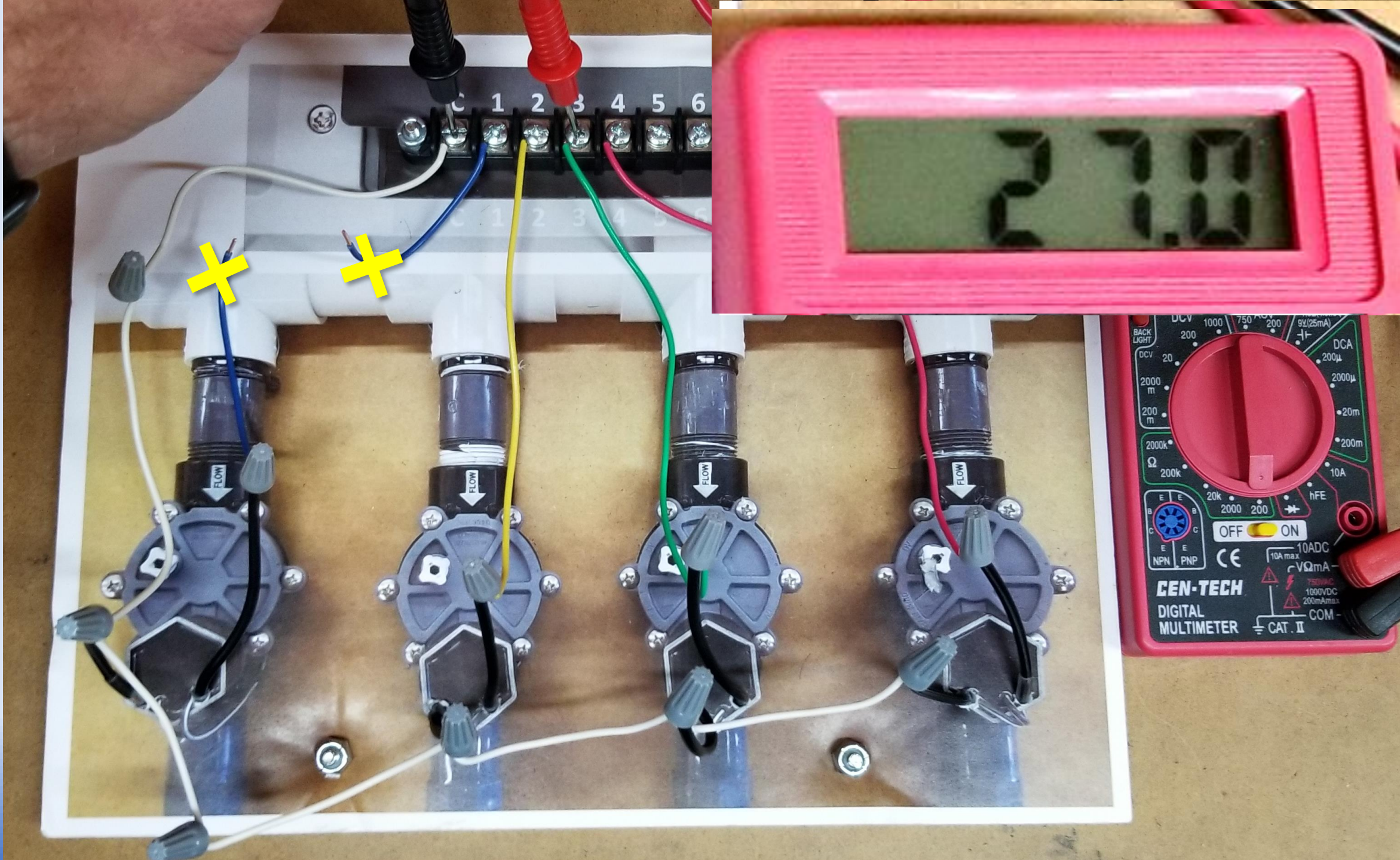


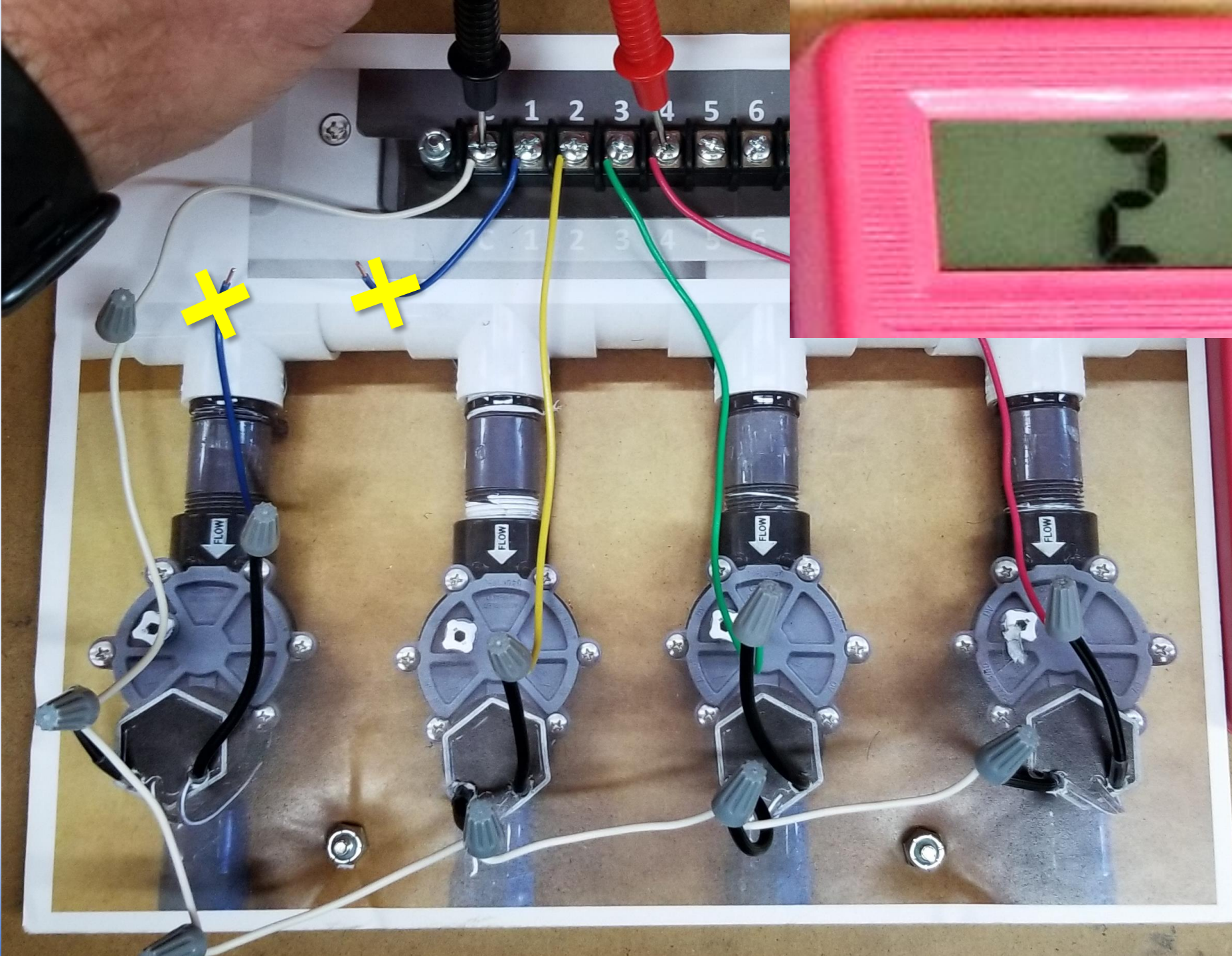
— 24vac Hot Wires

— 24vac Common Wire

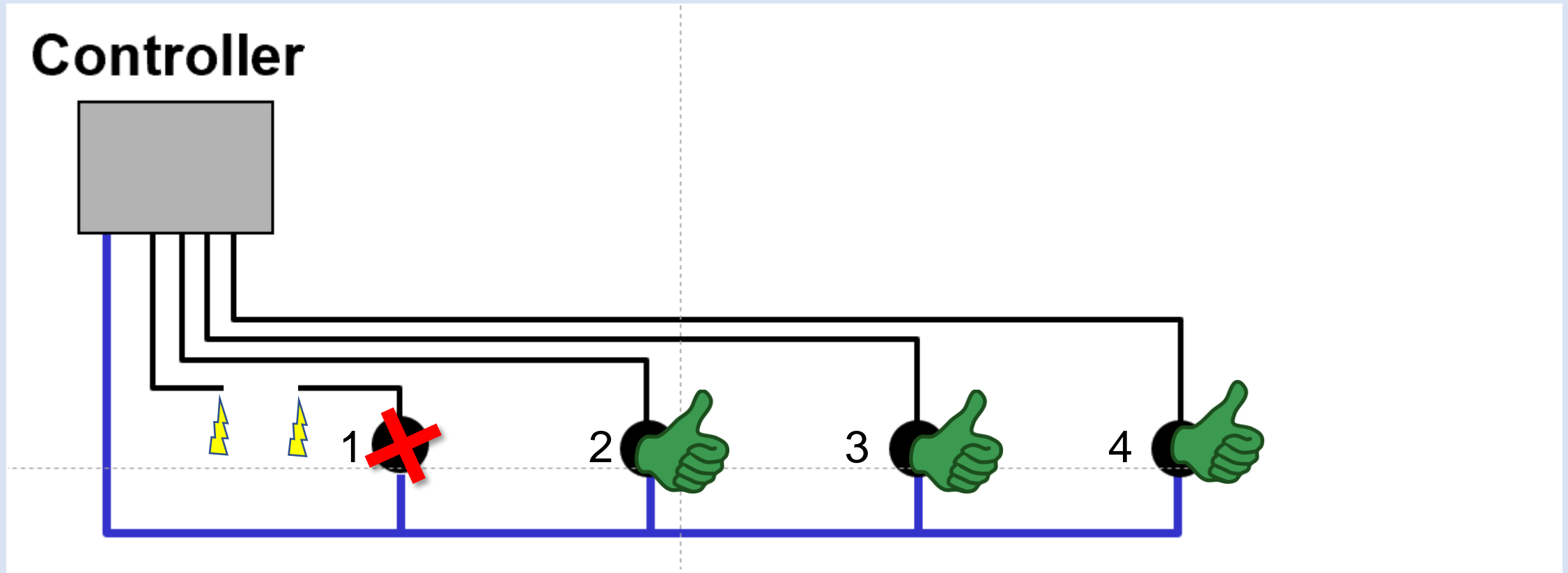








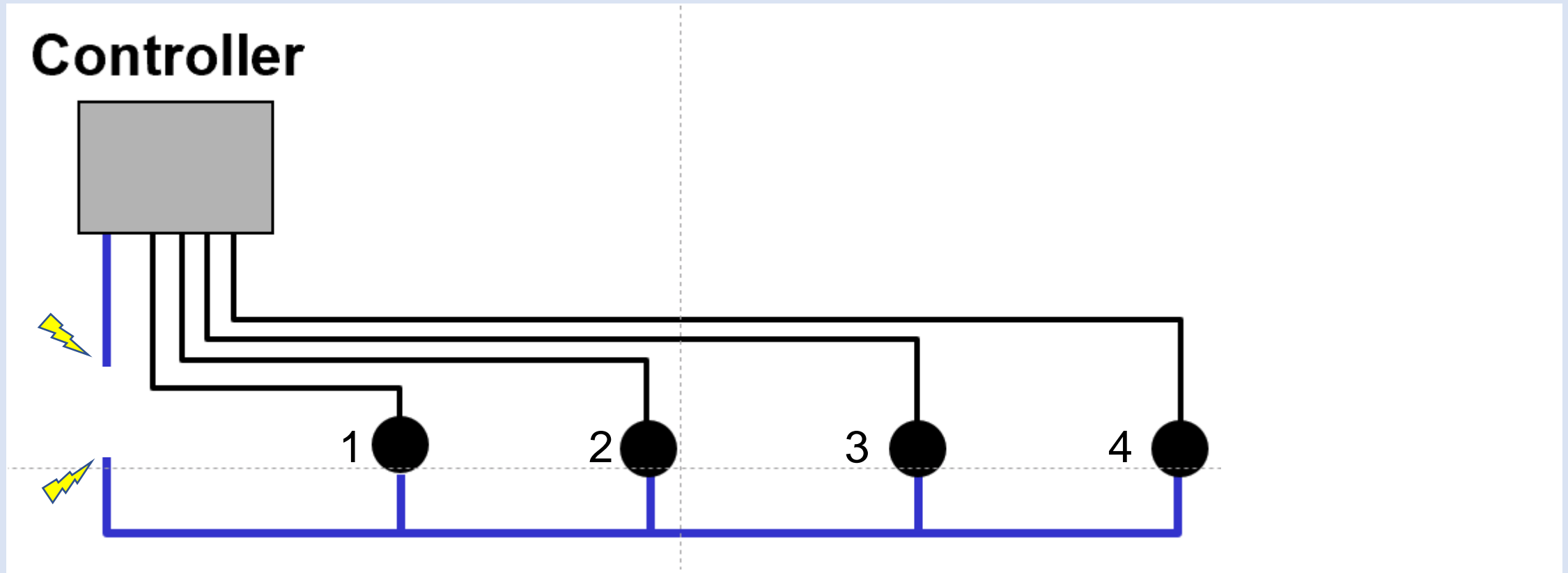
Hot (Station) Wire Open



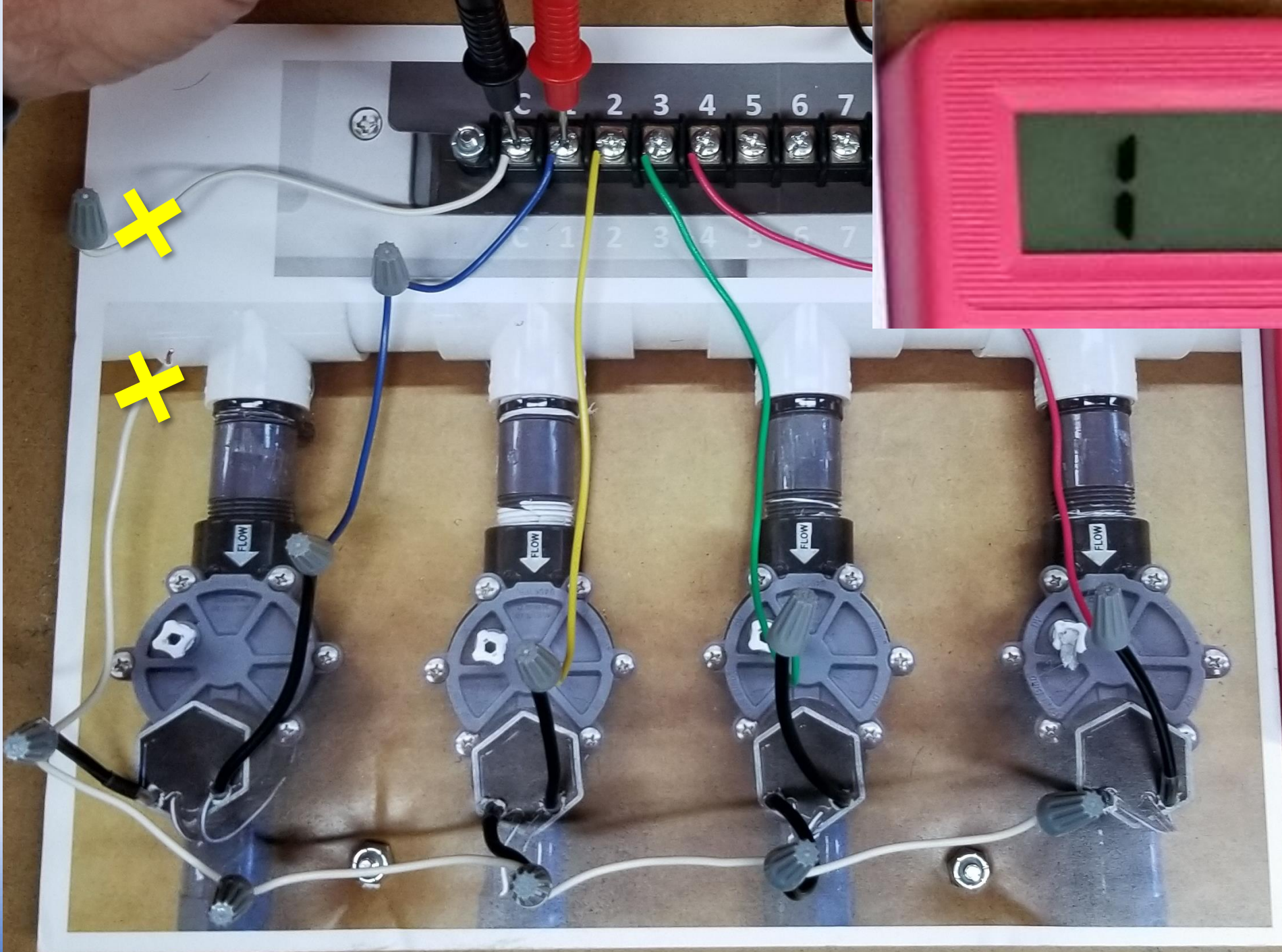
- 24vac Hot Wires
- 24vac Common Wire

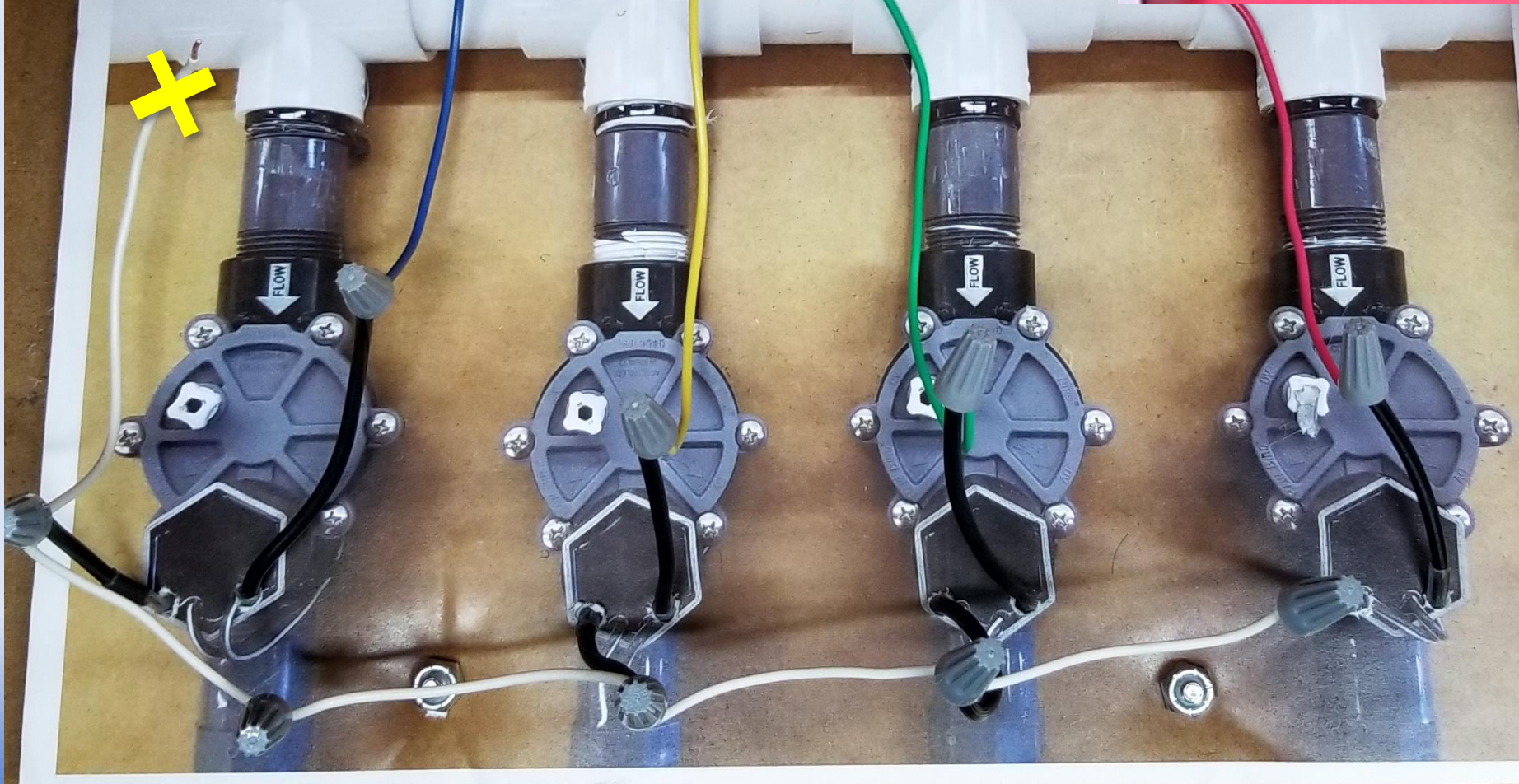
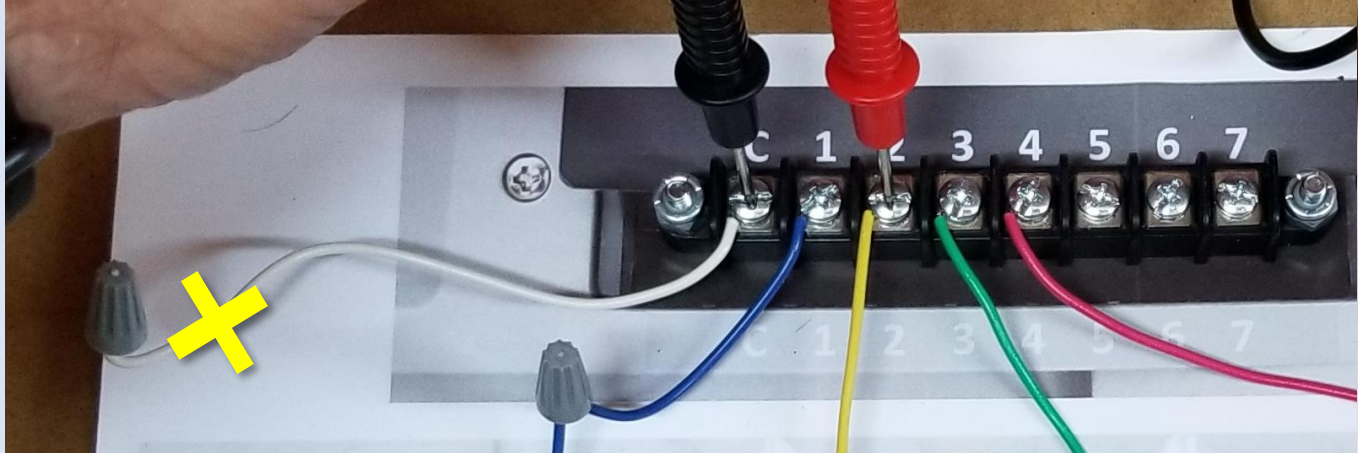
Common Wire Open Before First Valve

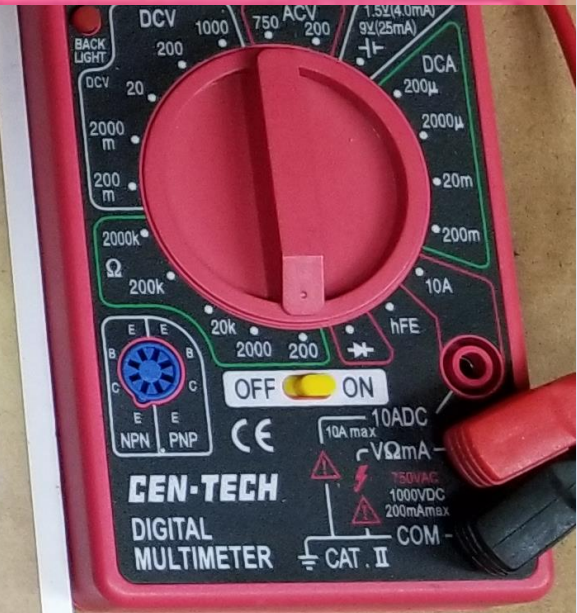
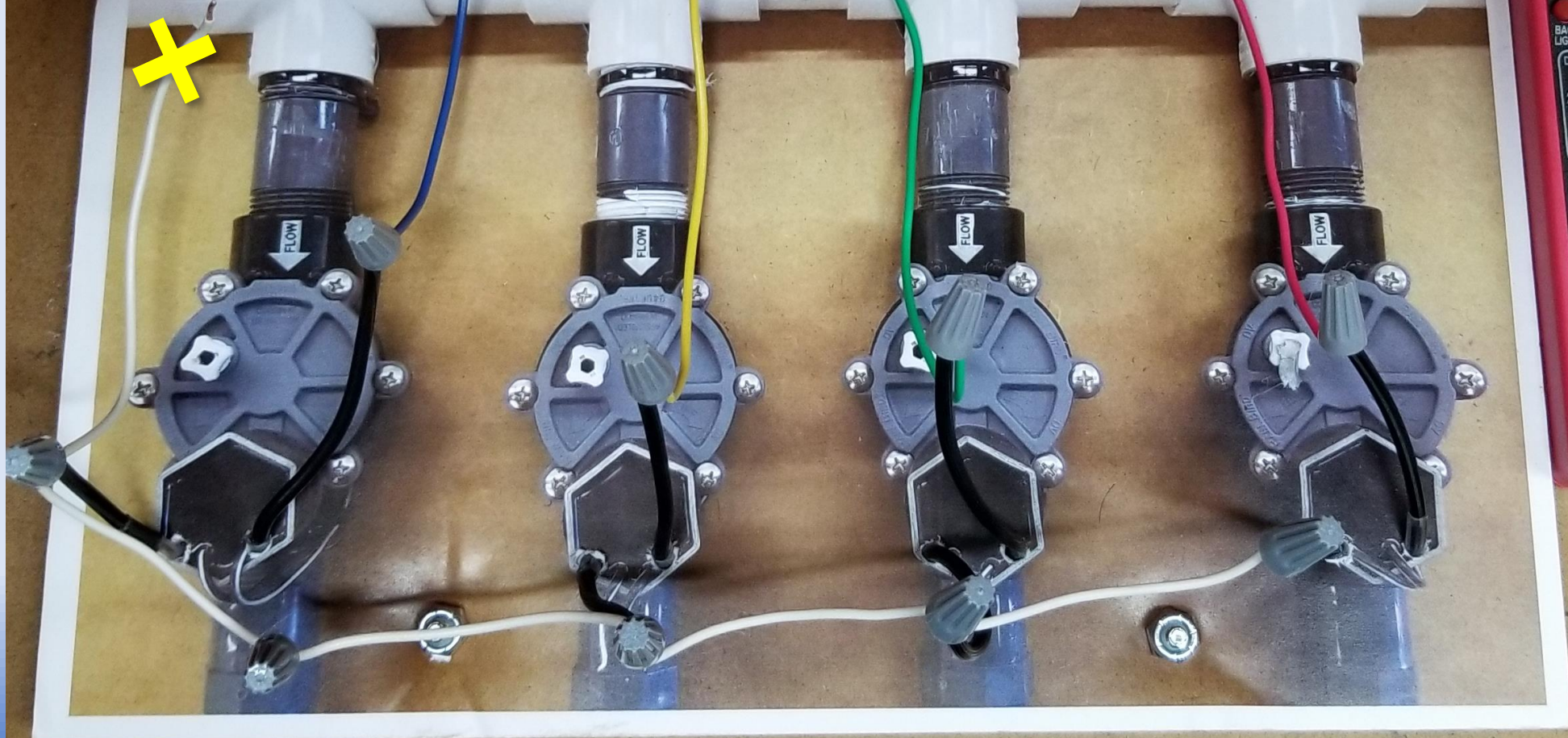
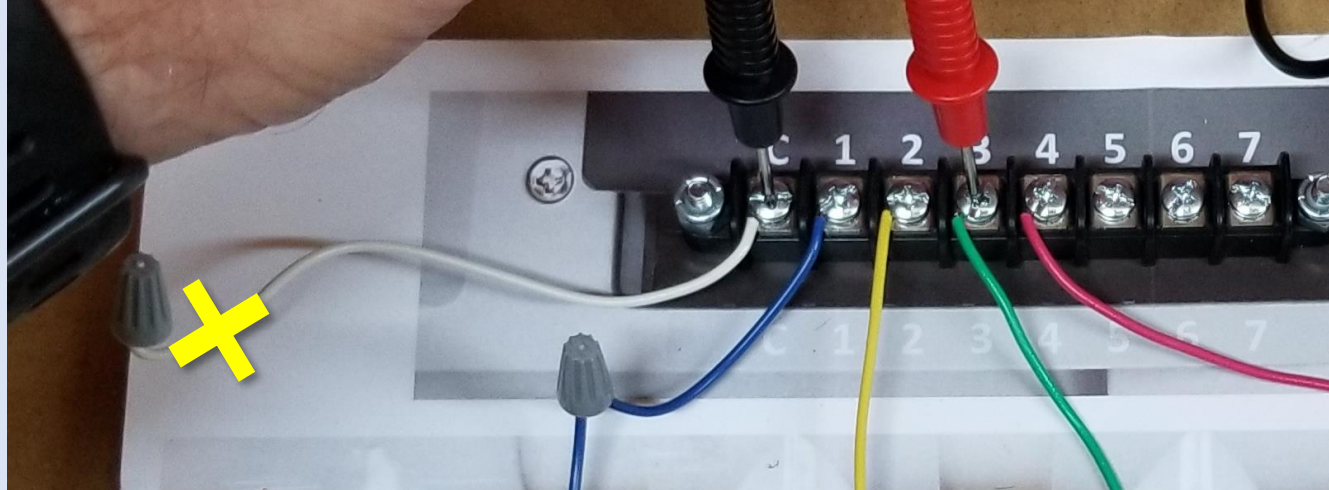
Common Wire Open Before First Valve

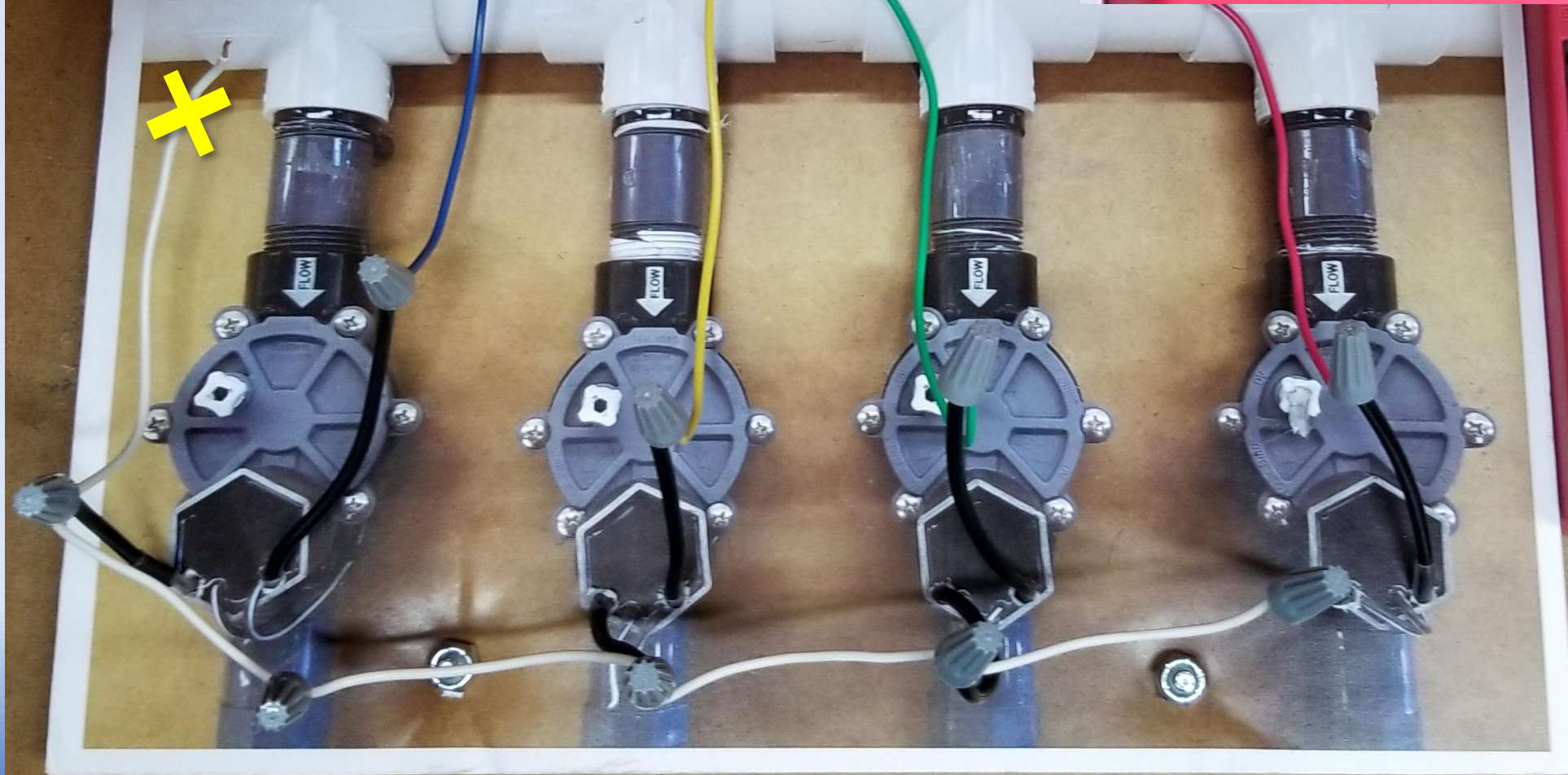
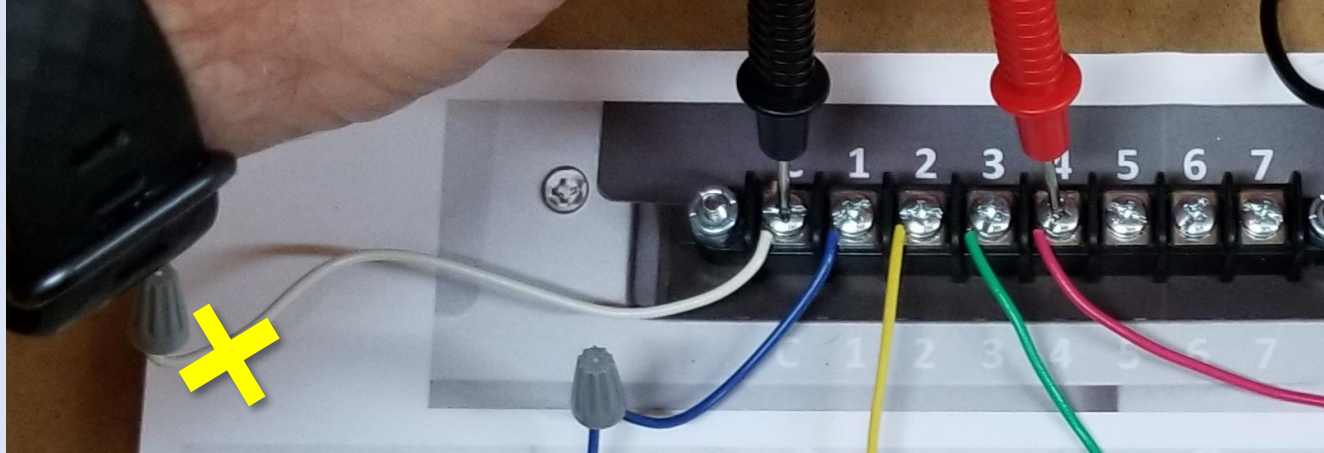


- 24vac Hot Wires
- 24vac Common Wire

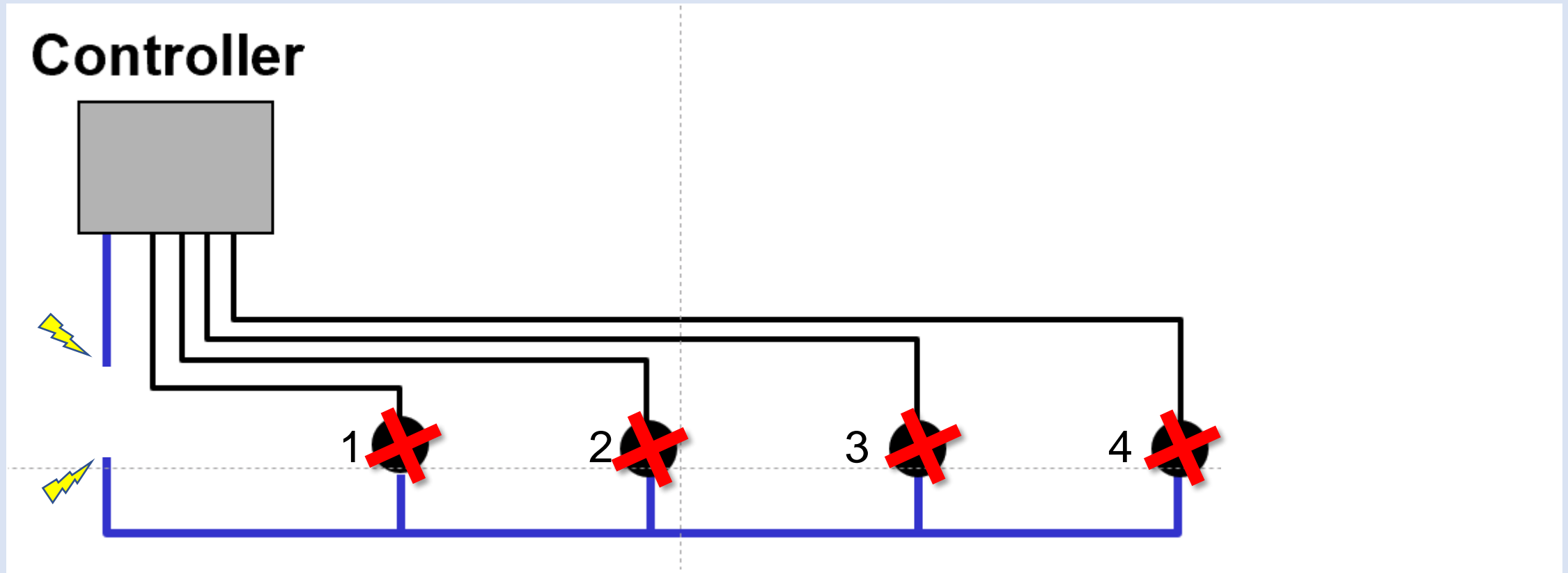








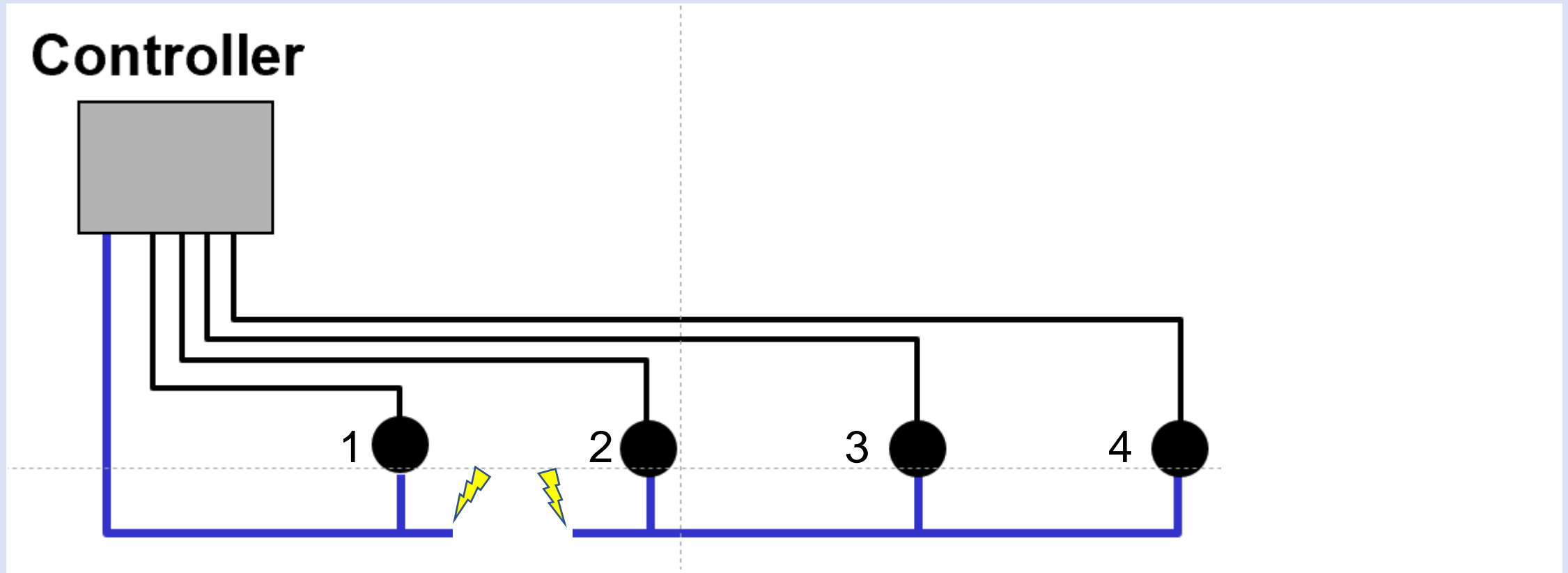
Common Wire Open Before First Valve



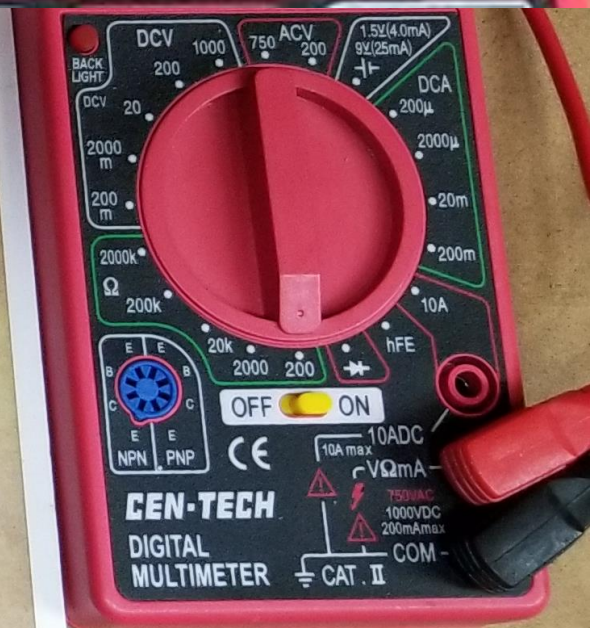
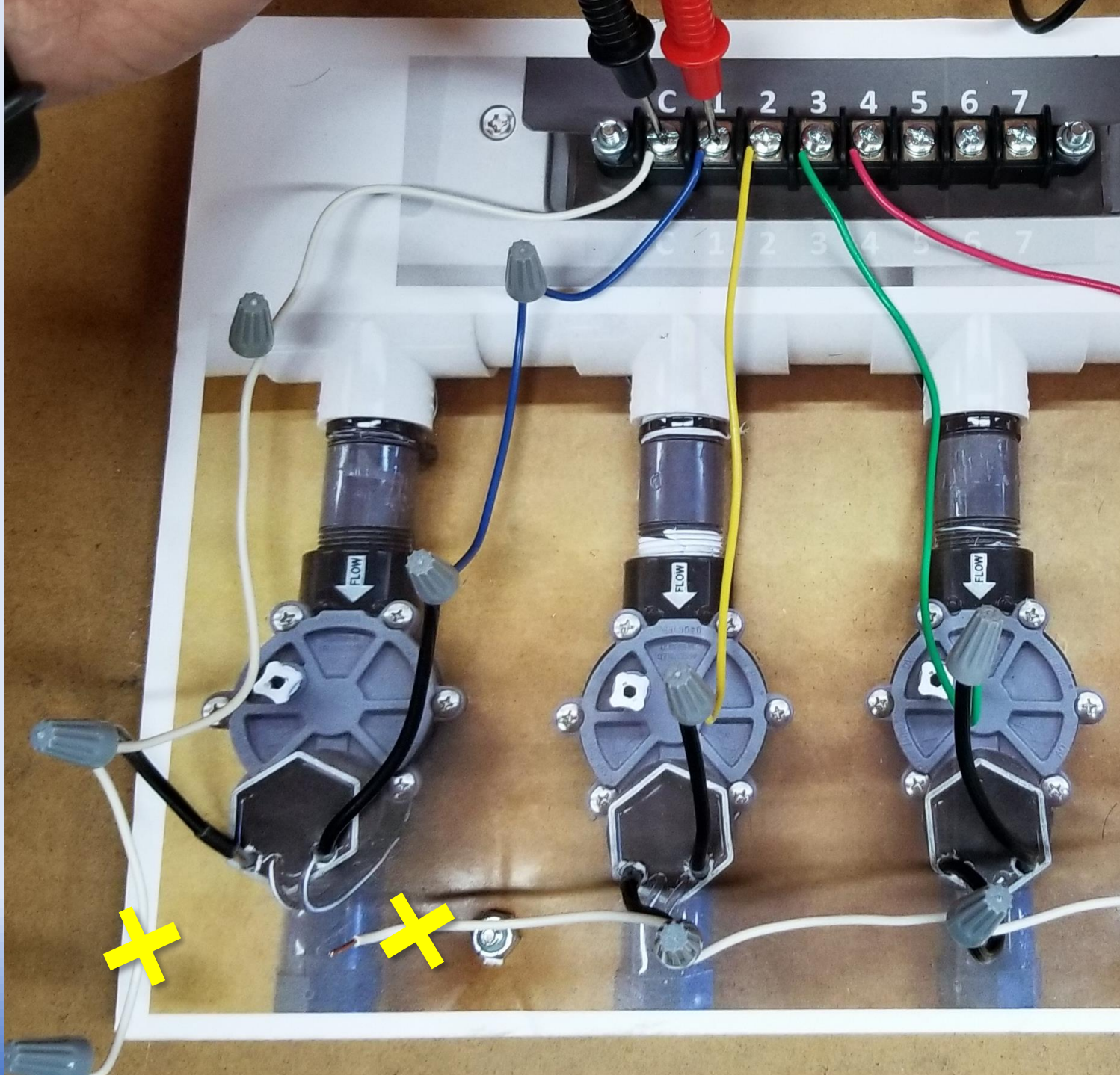
- 24vac Hot Wires
- 24vac Common Wire

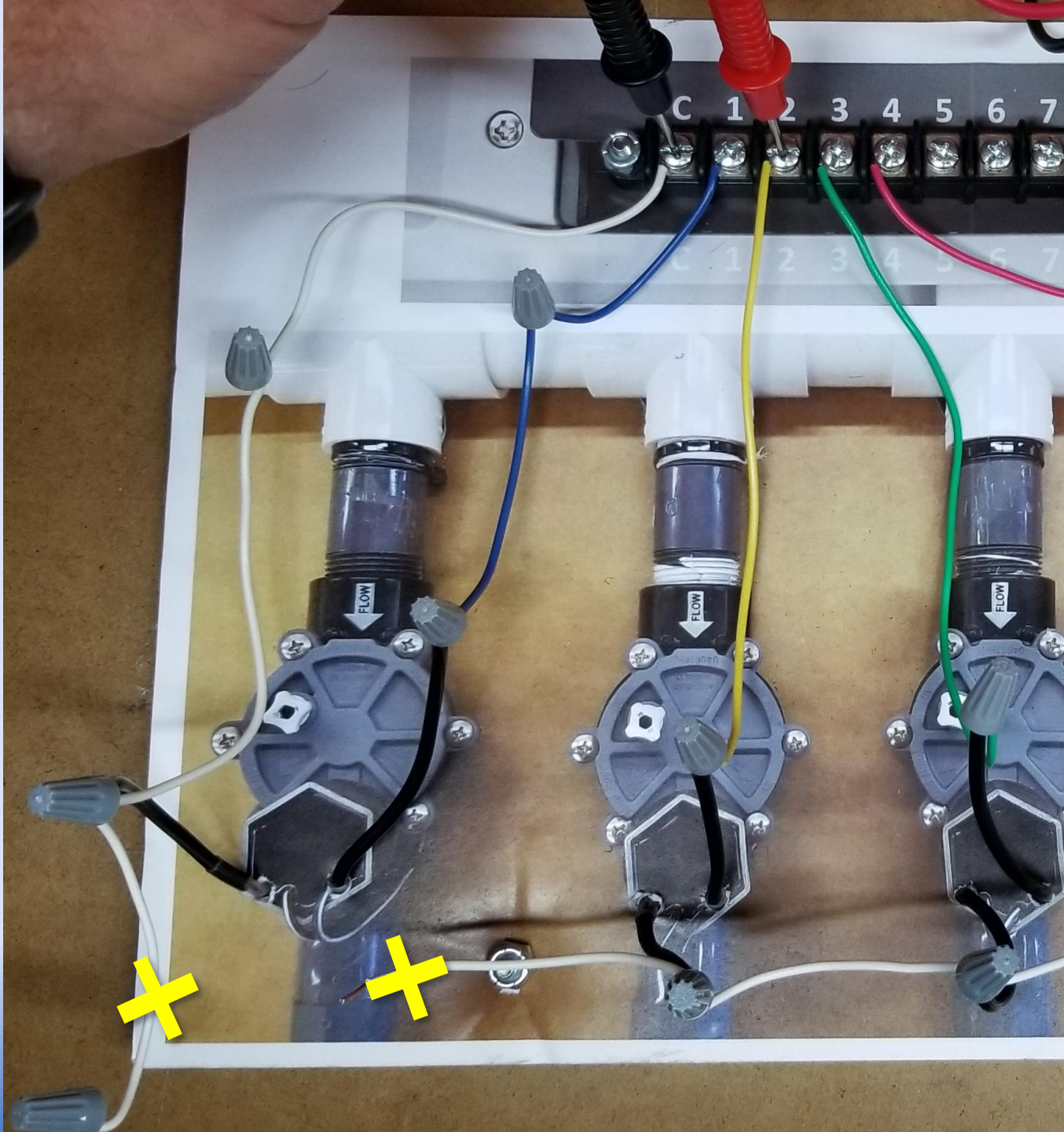
Common Wire Open After First Valve

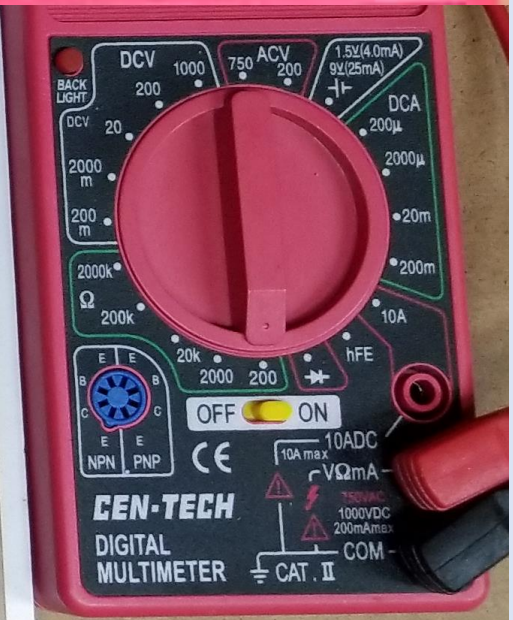
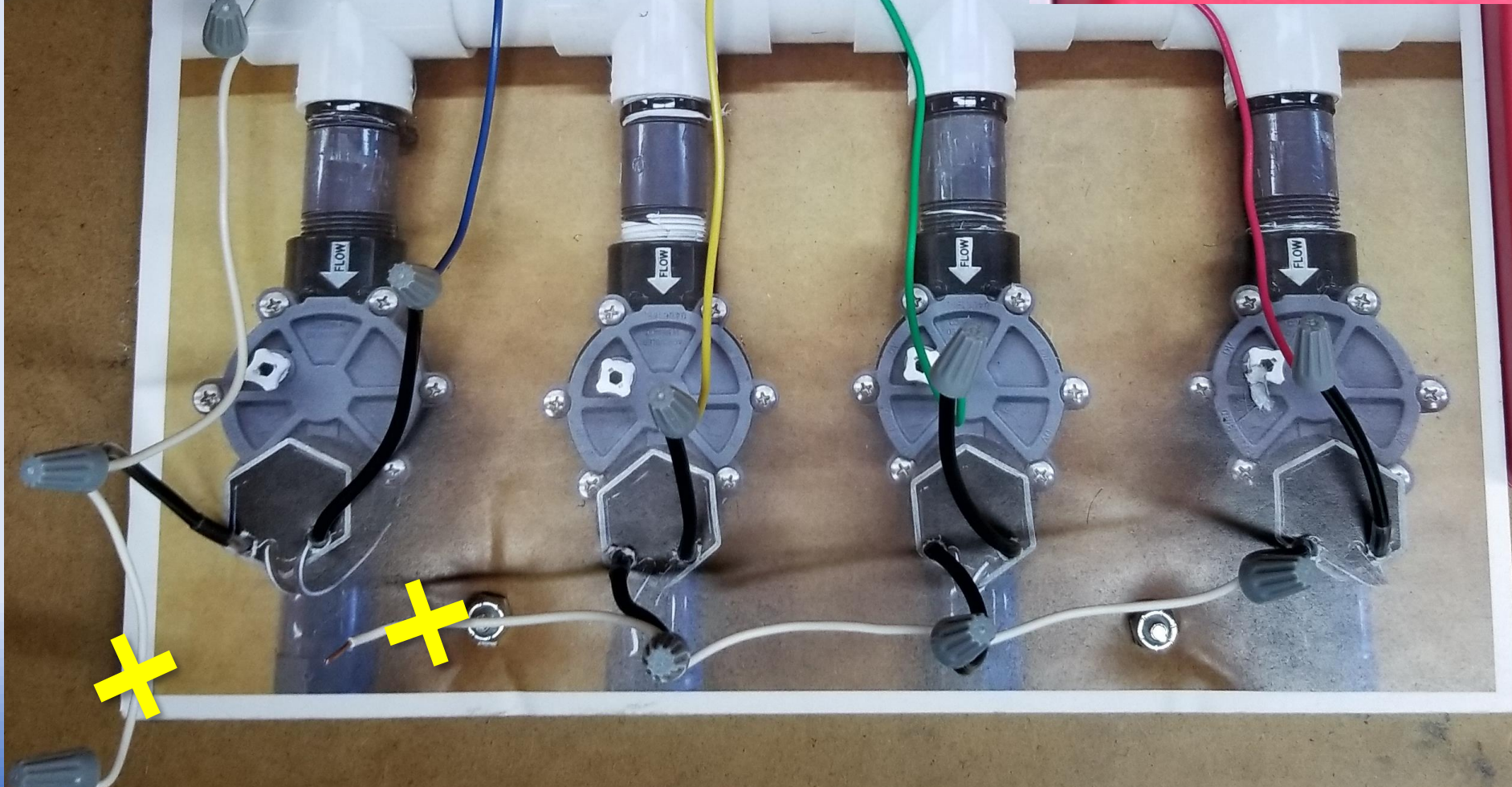
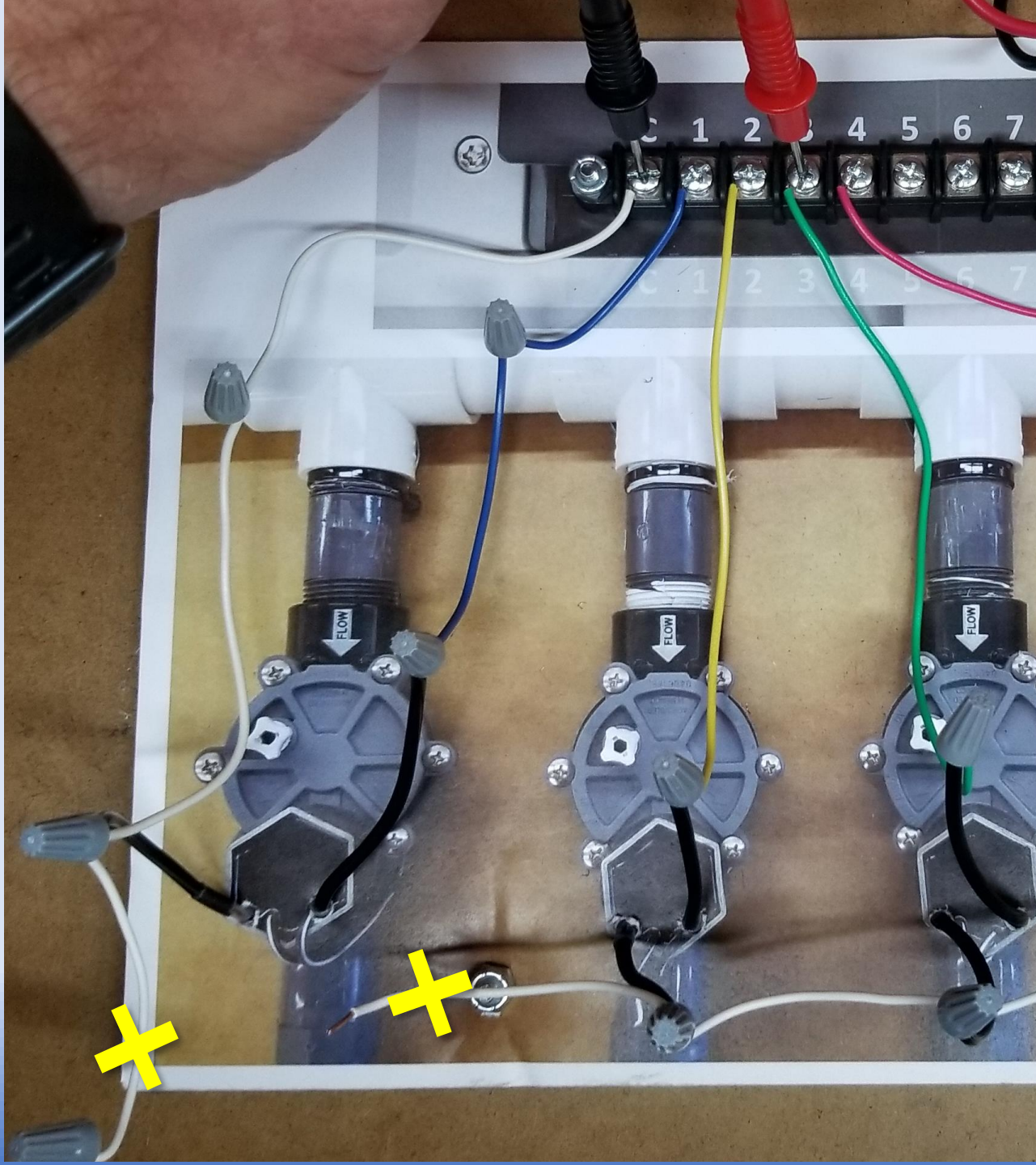
Common Wire Open After First Valve

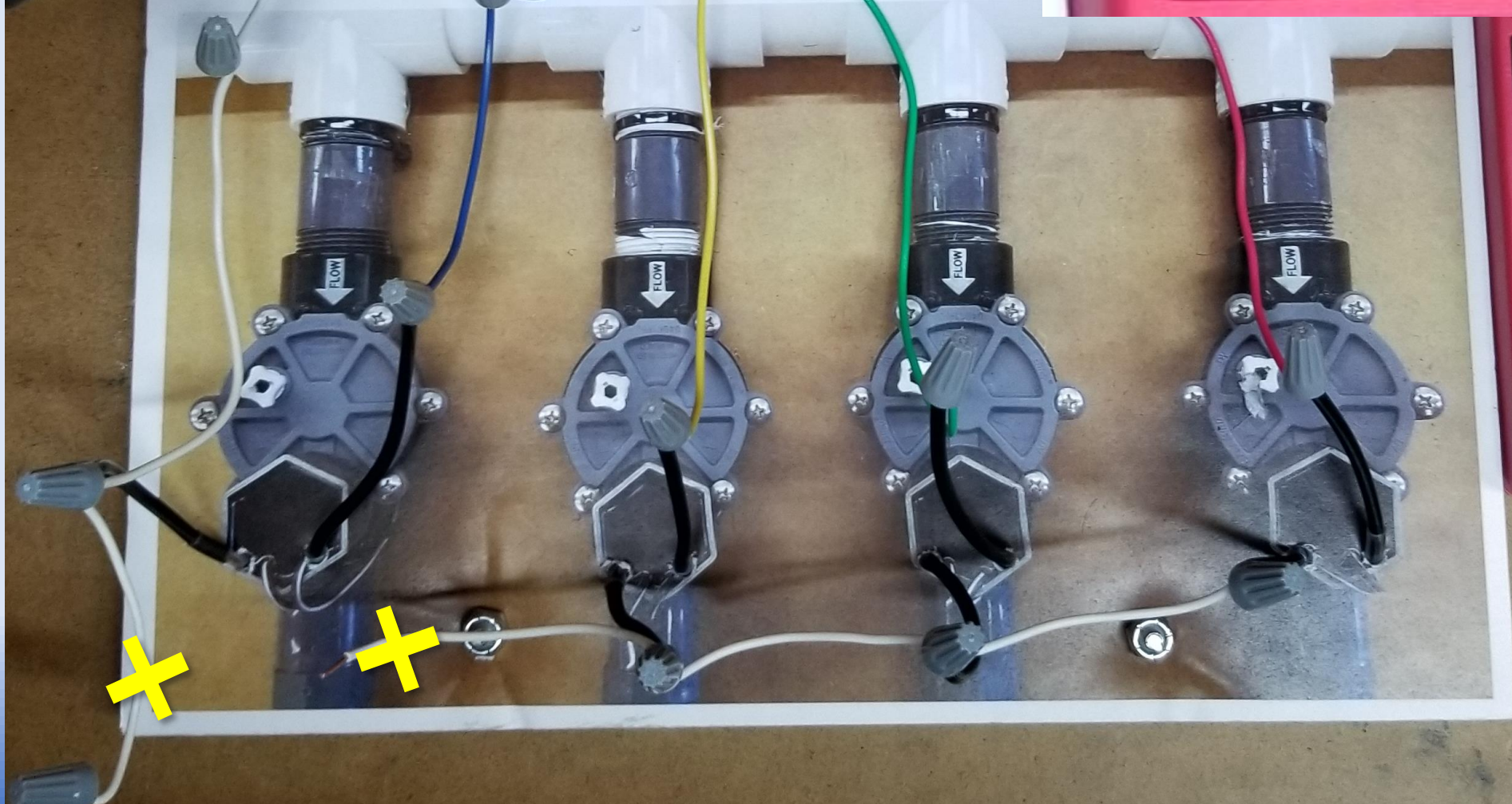
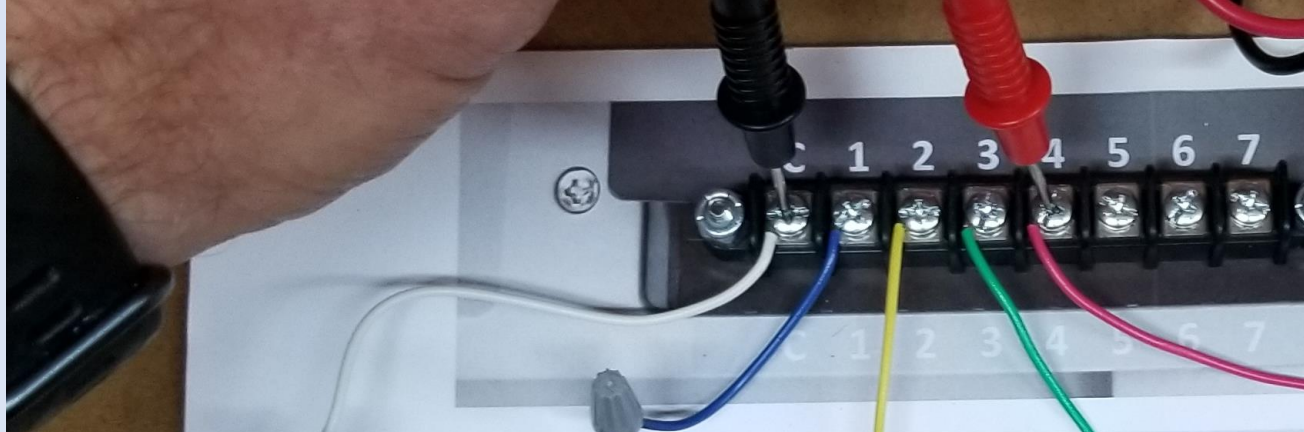


- 24vac Hot Wires
- 24vac Common Wire

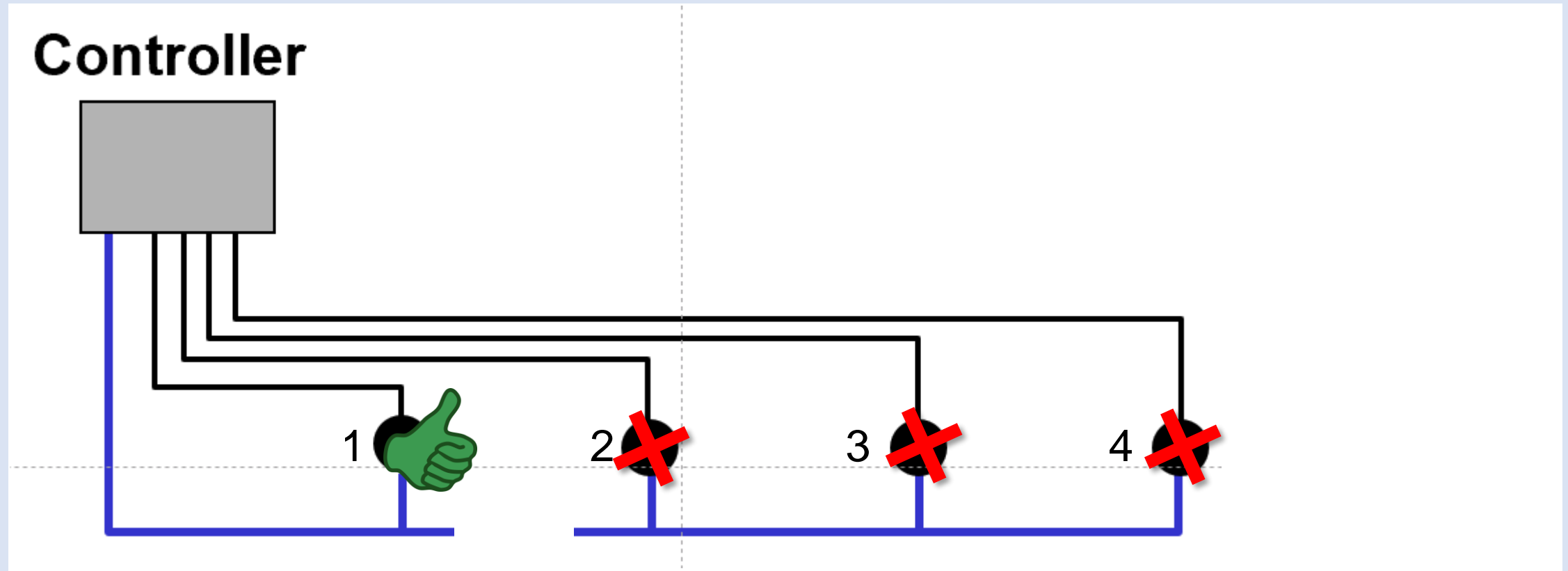








Common Wire After First Valve



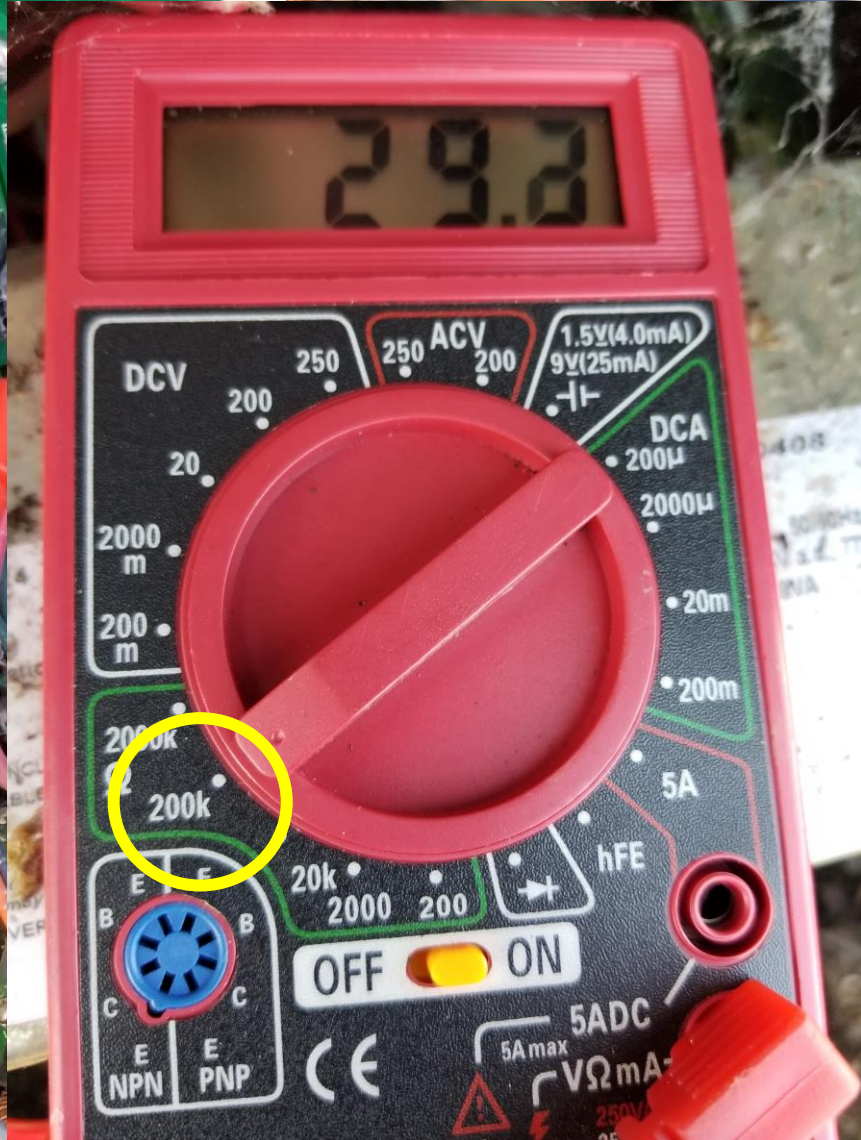
- 24vac Hot Wires
- 24vac Common Wire

Sprinkler WILL NOT Turn ON

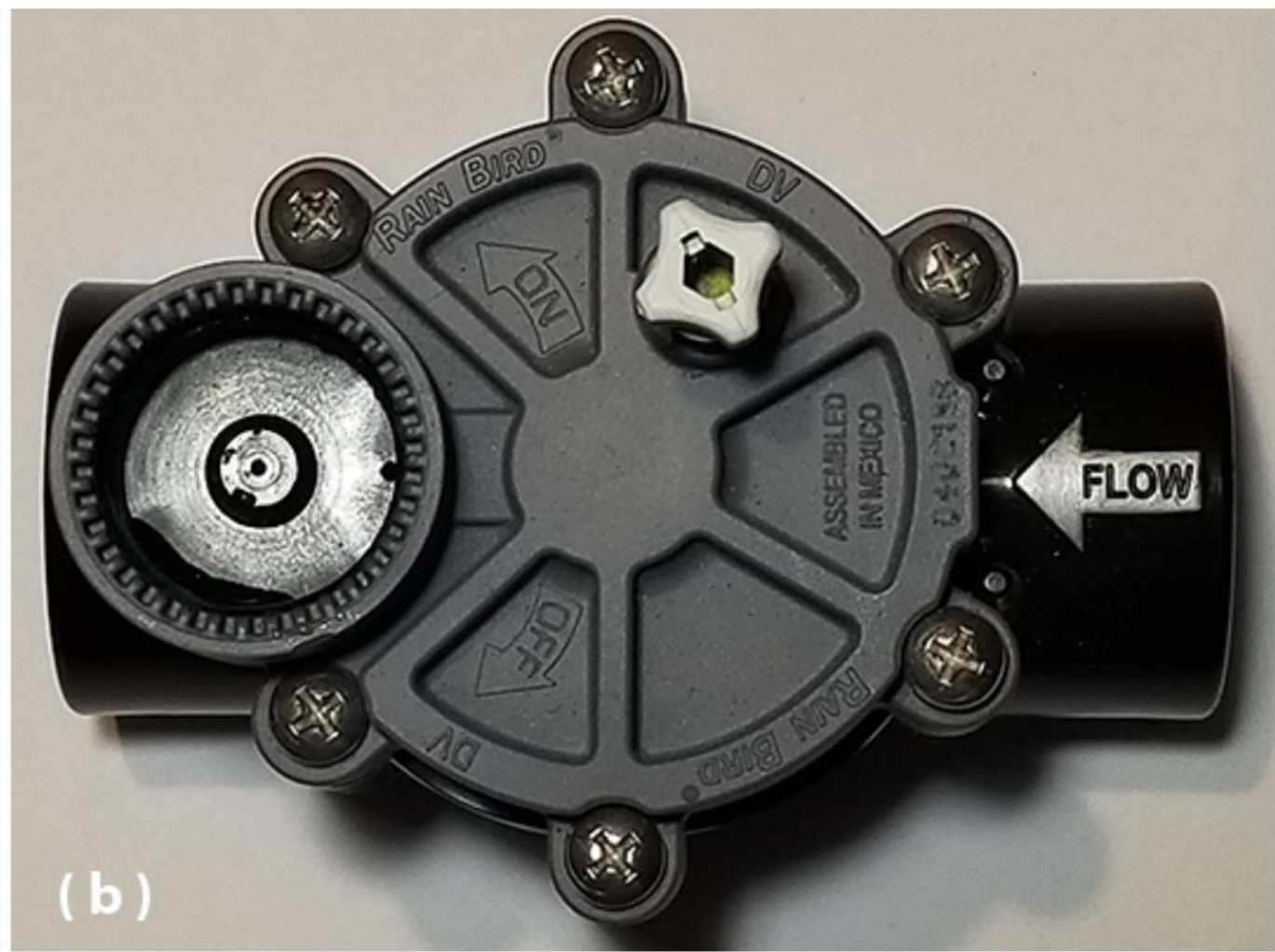
Process of Elimination:

Find out what it isn't

- Do I have water?
- Do I have power to the station?
 - Should be 24 Volts
- Is the signal getting to the solenoid and is it working?
 - 20 to 60 ohms (most of the time)
- Time to check the Valve







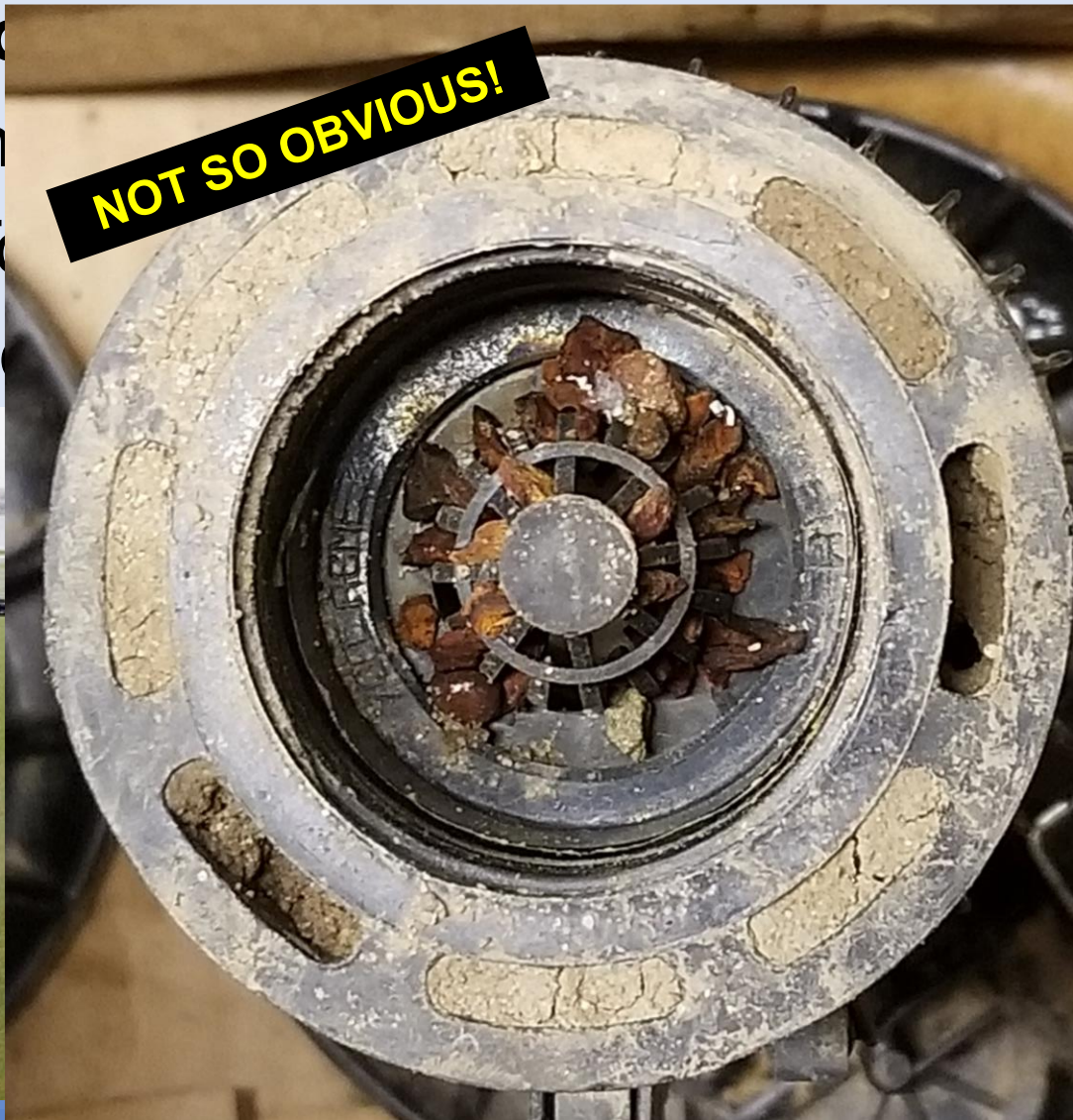
Low Pressure



Low Pressure



Pro
Fin
• To
• L



ous



Low Pressure

Process of Elimination:

Find out what it isn't

- Too Many Sprinklers?
- Leak? OR

Check the Obvious





Sprinklers WILL NOT Turn OFF



Sprinklers WILL NOT Turn OFF



Process of Elimination:

Find out what it isn't

- Are they still on if I turn off the controller?



Use Your Sense of Smell, Hearing



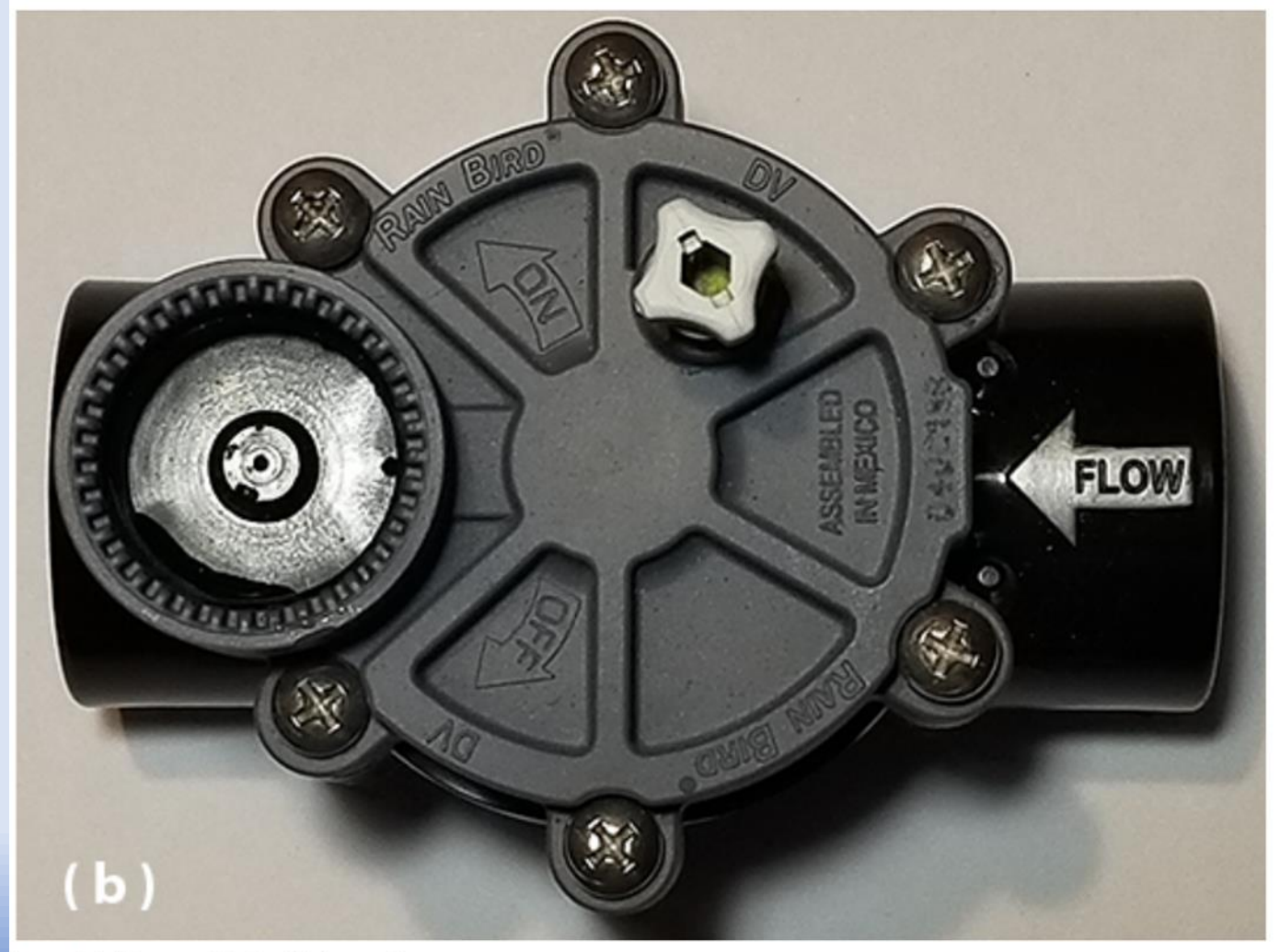
Smell like rotten eggs?

What do you hear?



Weeping Sprinkler Causes

- Debris in valve
- Cut in diaphragm
- Crack in bonnet
- Debris in solenoid port area
- Loose solenoid



Two Valves on One Station





Station Master

- Test solenoids for continuity
- Activate solenoids
- Send tones to ID wires



Repairs!! What parts do I need??



Pipe Fittings



A Couple Things You Need to Know

1. The type of pipe you are working with
 - PVC, Poly (PE), or HDPE, possibly galvanized
2. How they connect to each piece of pipe or fitting
 - Solvent weld, Iron pipe threads, ACME threads, Gaskets

Pipe and Fittings: Polyvinylchloride (PVC)





Fittings connect pipe to pipe and pipe to other components.

- PVC solvent weld
- PVC threaded fittings
- PVC insert fittings
- ACME fittings (O-rings)
- Gasketed Fittings (Knock ons)

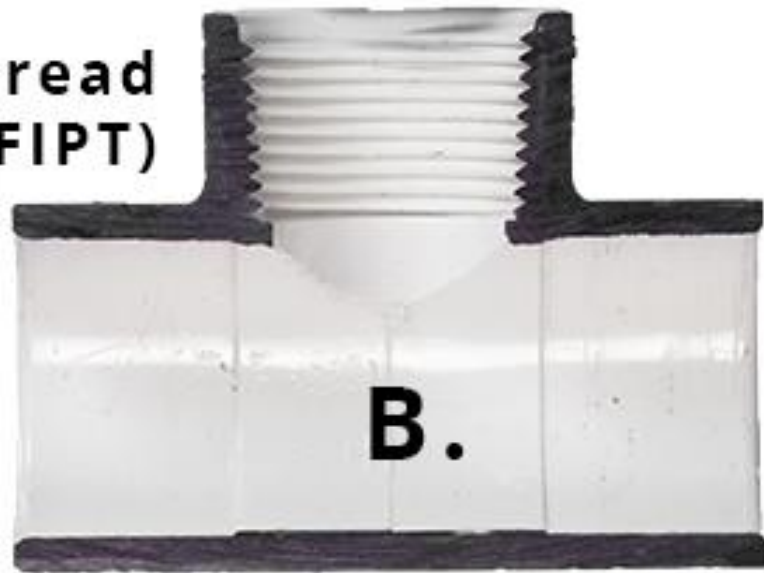
PVC Common Terms

- **S or Slip or Socket:** A regular hub. The pipe glues into this (same O.D. as coupling)
- **MIPS:** Male pipe threads on the outside of the fitting
- **FIPS:** Female pipe threads on the inside of the fitting
- **Mipt:** Male pipe threads on the outside of the fitting (same as MIPS)
- **Fipt:** Female pipe threads on the inside of the fitting (same as FIPS)
- **Spigot or SP:** The same size as the pipe. Will glue into another fitting
- **MAT:** Male ACME Fitting
- **FAT:** Female ACME Fitting
- **MHT:** Male hose threads (garden hose)
- **FHT:** Female hose threads (garden hose)
- **Insert:** Barbed fitting
- **Barb:** Barbed fitting
- **Saddle:** Attaches to the side of pipe



**Male Thread
(MIPT)**

**Female Thread
(FIPT)**



**Slip / Socket
(Soc)**

**Slip / Socket
(Soc)**

Nipple Pipe

Nipple Pipe

Short sections of pipe threaded on one or both ends

- TBE nipple = **T**hreaded **B**oth **E**nds
- TOE nipple = **T**hreaded **O**ne **E**nd



Socket



Spigot

Insert Fittings



- Also called barbed fittings
- Used on PE pipe laterals
 - not for main line
- Secured with clamp
 - screw-type
 - crimp-type





ACME Fittings

- Utilize an O-Ring Seal
- Fewer threads, blunted
- Allows flexibility



Pipe and Fittings: Polyethylene (HDPE)

- HDPE fittings are usually heat fused together for mainlines and laterals



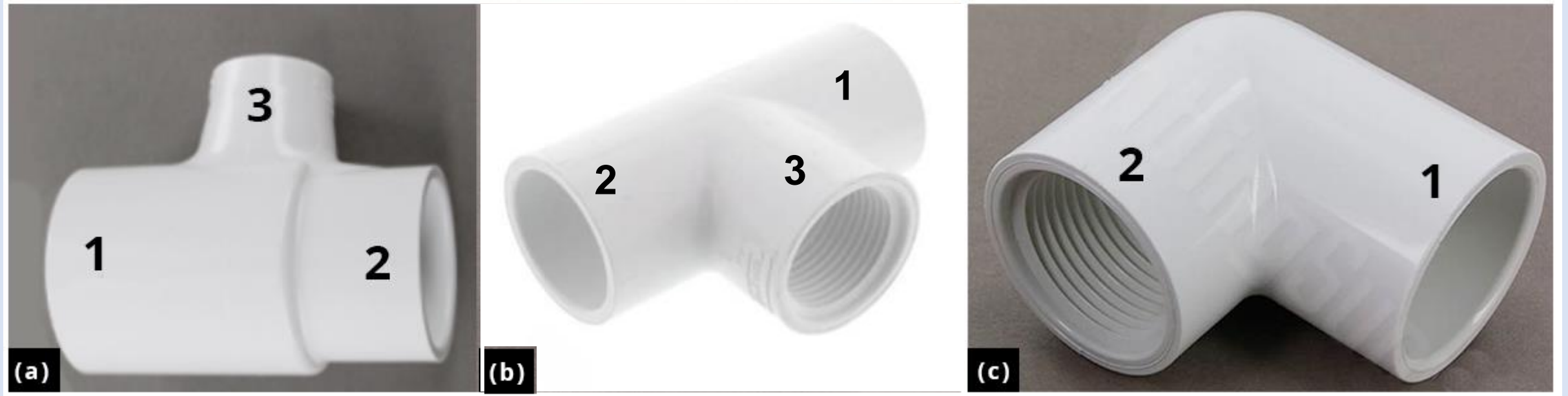
PVC Fittings

There are many configurations of fittings used for irrigation:

- Tees
- Els
- Couplers
- Adapters
- Bushings
- Specialty (Repair and Install)

Let's look at some examples

Describing Fittings



a: is a: (1) 1-inch x (2) $\frac{3}{4}$ -inch x (3) $\frac{1}{2}$ -inch reducer TEE. (1) Slip x (2) Slip x (3) Slip (SxSxS).

b is a: (1) 1-inch x (2) 1-inch x (3) 1-inch Service TEE. (1) Slip x (2) Slip x (3) FIPT (SxSxFIPT)
(it may also be called just a 1-inch service TEE, or referred to as a combo TEE)

c is a: (1) 1-inch by (2) 1-inch Service EL. (1) Slip by (2) FIPT (or combo EL)



1-inch male adapter MA, Slip by MIPT.

If it was adapting from 1-inch slip to $\frac{3}{4}$ -inch male threads, it would be referred to as a reducing male adapter

TEES



SPEARS : 401-010

Sch 40 PVC Tee 1 in. Socket



1" PVC Sch 40 Tee

1" Schedule 40 PVC Tee Socket,

1 in. Slip x Slip x Slip PVC Schedule 40 Tee



a.k.a
Combo Tee
Service Tee

**1" PVC Sch. 40 Threaded Tee (Socket
x FIPT)**

SPEARS : 402-010

Sch 40 PVC Tee 1 in. Socket x FIPT

**1 Slip x Slip x FPT
Sch40 Tee**

1 in. Slip x Slip x Fipt PVC Schedule 40 Tee

1" Schedule 40 PVC Tee Socket X Socket X Thread,



SPEARS : 1401-010

Poly Insert Tee 1 in. x 1 in. x 1 in.

**1 Inserts Tee Insert
x Insert x Insert**



BLAZING : BLZ1401-010

Blazing Poly Insert Campless Tee 1 in. x 1 in. x 1 in.

SPEARS : 1402-130

Poly Insert Combination Reducing Tee 1 in. x 1 in. x 1/2 in. Insert x Insert x FIPT



a.k.a

**Combo Tee
Service Tee**

**1 x 1 x 1/2 Inserts
Combination Tee
Insert x Insert x
FPT**

112-330

Sch 40 PVC Tee 3 in. x 3 in. x 3 in. Gasket



Specifications

Item	Tee
Connection Size	3 in. x 3 in. x 3 in.
Material	PVC
Connection Type	Gasket
Wall Thickness	Sch 40

HARCO : 151-306

Harco SDR-21 PVC Service Tee 3 in. x 1-1/2 in. Gasket x FIPT



Item	Tee
Connection Size	3 in. x 1-1/2 in.
Material	PVC
Connection Type	Gasket x FIPT
Wall Thickness	SDR-21

ELBOWS (ELS)



1" PVC Sch. 40 90° Elbow

1" Schedule 40 PVC 90 Elbow Socket,

SPEARS : 406-010

Sch 40 PVC 90 Degree Elbow 1 in. Socket

**1 Slip x Slip Sch40
90 degree Elbow**



1" PVC Sch. 40 90° Elbow (Socket x FIPT)

SPEARS : 407-010

Sch 40 PVC 90 Degree Elbow 1 in. Socket x FIPT

1" Schedule 40 PVC 90 Elbow Socket X Thread,

a.k.a
Combo El
Service El

**1 Slip x FPT Sch40
90 degree Elbow**



SPEARS : 1406-010

Poly Insert 90 Degree Elbow 1 in. x 1 in.



SPEARS : 1407-130

**Poly Insert 90 Degree Combination Reducing
Elbow 1 in. x 1/2 in. Insert x FIPT**

a.k.a

Combo El
Service El



SPEARS : 410-010

Sch 40 PVC 90 Degree Street Elbow 1 in. MIPT x
Socket

Street El: Male and Female Ends



1" Schedule 40 PVC 90 Street Elbow Spigot X FPT,



MAT – Male Acme Thread

1in ACME X ACME
Irrigation 90
degree Street
Elbow

<https://www.lascofittings.com/swing-joint-configurator>

FAT – Female Acme Thread

DIAMETER SIZE:

(3) 1 1/2 inch

INLET STYLE:

(M) 1 1/2 ACME (from service fitting)

OUTLET STYLE:

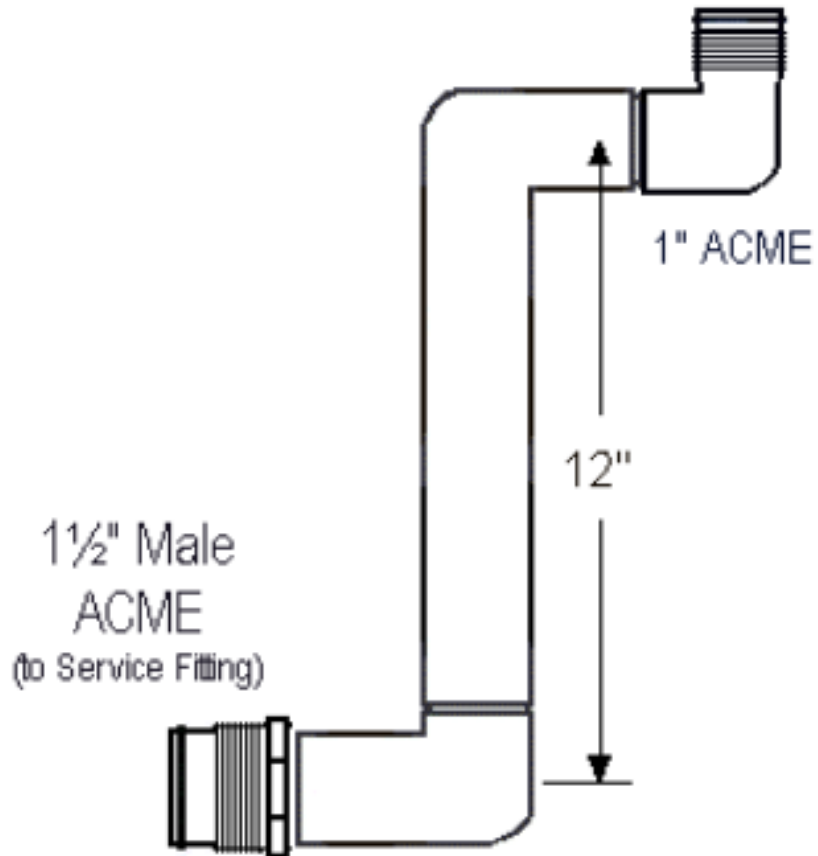
(C) ACME (to 1in head)

SWING JOINT STYLE:

(2) Standard Unitized

LAY LENGTH:

(12) 12 Inches



DIAMETER SIZE:

(3) 1 1/2 inch

INLET STYLE:

(3) MIPT

OUTLET STYLE:

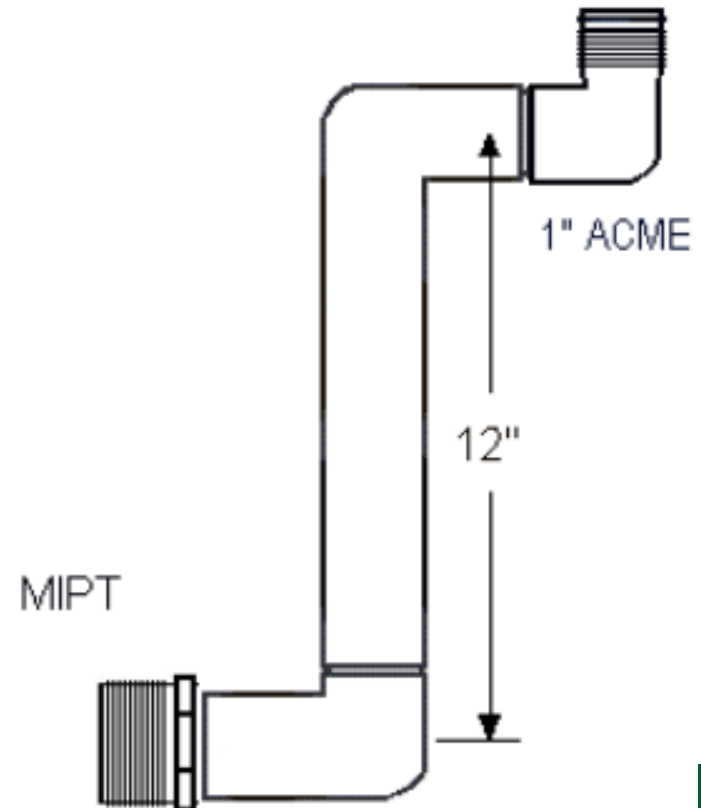
(C) ACME (to 1in head)

SWING JOINT STYLE:

(2) Standard Unitized

LAY LENGTH:

(12) 12 Inches



HARCO : 118-030

Harco Sch 40 PVC 90 Degree Elbow 3 in. Gasket



Specifications

Item	Elbow
Connection Size	3 in.
Material	PVC
Connection Type	Gasket
Wall Thickness	Sch 40

COUPLINGS

Couplings are used when joining **like-joints**



SPEARS : 429-010

Sch 40 PVC Coupling 1 in. Socket



1" PVC Schedule 40 Coupling

**1 Slip x Slip Sch40
Coupling**

1" PVC Sch. 40 Coupling (FIPT)



**1 FPT x FPT Sch40
Coupling**

Sch 40 PVC Coupling 1 in. FIPT

SPEARS : 1429-010

Poly Insert Coupling 1 in. x 1 in.



**1 Inserts Coupling
Insert x Insert**

SPEARS : 1429-010

Poly Insert Coupling 1 in. x 1 in.



**1 Inserts Coupling
Insert x Insert**

ADAPTERS

Adapters are used when joining
NOT-like-joints



1-inch male adapter MA, Slip by MIPT.



If it was adapting from 1-inch slip to $\frac{3}{4}$ -inch male threads, it would be referred to as a reducing male adapter

1" PVC SCH 40 Male Adapter

SPEARS : 436-010

Sch 40 PVC Male Adapter 1 in. MIPT x Socket

1" Schedule 40 PVC Male Adaptor MPT X Socket,

**1 MPT x Slip Sch40
Male Adapter**



CUIDADO! BE CAREFUL!



1 x 1¼ MPT x Slip Sch40 Reducing Male Adapter

List Price: \$7.68 USD

Product ID: 436132

Size:	1 x 1¼
Carton Quantity:	25
Code:	01/B1
Pallet Quantity:	6000

CUIDADO! BE CAREFUL!



1 x 1¼ MPT x Slip Sch40 Reducing Male Adapter

List Price: \$7.68 USD

Product ID: 436132

Size:	1 x 1¼
Carton Quantity:	25
Code:	01/B1
Pallet Quantity:	6000

SPEARS : 1436-010

**Poly Insert Male Adapter 1 in. x 1 in. MIPT x
Insert**



**1 Inserts Male
Adapter Insert x
MPT**

1" PVC Schedule 40 Female Adapter



**1 Slip x FPT Sch40
Female Adapter**

Sch 40 PVC Female Adapter 1 in. Socket x
FIPT

SPEARS : 1435-010

**Spears PVC Insert Female Adapter 1 in. x 1 in.
FIPT x Insert**



**1 Inserts Female
Adapter Insert x
FPT**



???

**1 Insert x Slip
Sch40 Adapter**



Sch 40 PVC Insert Adapter 1 in. Insert x
Socket

BUSHINGS

Bushings are intended to get you quickly from one size (and possibly joint type) to another





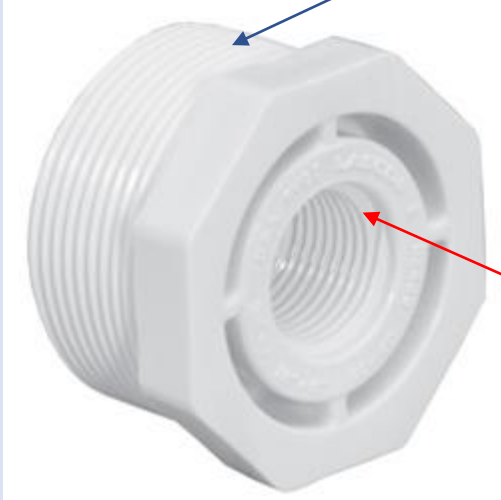
**1 x 1/2 MPT X FPT
Sch40 Threaded
Reducer Bushing**

1" x 1/2" PVC SCH 40 M x F Bushing



**Sch 40 PVC Reducing Bushing 1 in. x 1/2
in. MIPT x FIPT**

Cuidado! (Again)



**1 x 1/2 MPT X FPT
Sch40 Threaded
Reducer Bushing**



**Sch 40 PVC Reducer Bushing Flush Style
2 in. x 3/4 in. Spigot x FIPT**



**1 x 1/2 MPT X FPT
Sch40 Threaded
Reducer Bushing**

1" x 1/2" PVC SCH 40 M x F Bushing



**Sch 40 PVC Reducing Bushing 1 in. x 1/2
in. MIPT x FIPT**



SPEARS : 437-211

Sch 40 PVC Reducer Bushing Flush Style 1-1/2 in. x 1 in. Spigot x Socket

Log in to
see your
price



In Stock at State C
[Check Other Stores](#)

Pick-Up, Delivery, or



Branch Pick-



438-248

Sch 40 PVC Reducer Bushing Flush Style 2 in. x 3/4 in. Spigot x FIPT

Log in to
see your
price



In Stock at State C
[Check Other Stores](#)

Pick-Up, Delivery, or
Shipping



Branch Pick-
Up



Local Delivery

ACME Bushing Adapters

Adapting Swing Joints and Sprinklers

1 ½", 1 ¼", 1"



1-1/2" Models



Bushing, Adapter, 1½" male ACME x 1" female NPT

Bushing, Adapter, 1½" male ACME x 1" female BSP

Bushing, Adapter, 1½" male ACME x 1¼" female NPT

Bushing, Adapter, 1½" male ACME x 1¼" female BSP

Bushing, Adapter, 1½" male ACME x 1½" female NPT

Acme x Acme Models



Bushing, Adapter, 1½" male ACME x 1" ACME female

Bushing, Adapter, 1½" male ACME x 1¼" ACME female

Bushing, Adapter, 1¼" male ACME x 1" ACME female

Specialty Fittings

- Repair fittings
 - compression couplers
 - telescopic couplers
- Unions
 - Schedule 40 or Schedule 80
 - threaded or socket
- Saddles
 - Schedule 40 or Schedule 80
 - threaded or socket



123

*Courtesy of
Spears and LASCO*



**Spears PVC Expansion Repair Coupling 2
in. Spigot x Socket**



**1" PVC Sch. 40 Repair Coupling (Soc
x Soc - PVC White with EPDM O-
ring)**



**1" PVC Sch. 40 Female Union w/
Buna O-ring**

Sch 40 PVC Union 1 in. FIPT with Buna-N
O-Ring Seal



**1" PVC Sch. 40 Socket Union w/
Buna O-ring**

Sch 40 PVC Union 1 in. Socket with Buna-
N O-Ring Seal

UNION



Recap

- Learn what you have and the system's capabilities
- Simplify the trouble shooting process
- Find out what it isn't
- Develop a Check List or Flow Chart
- Use all of your senses



Knowing the little things
will help you avert disaster

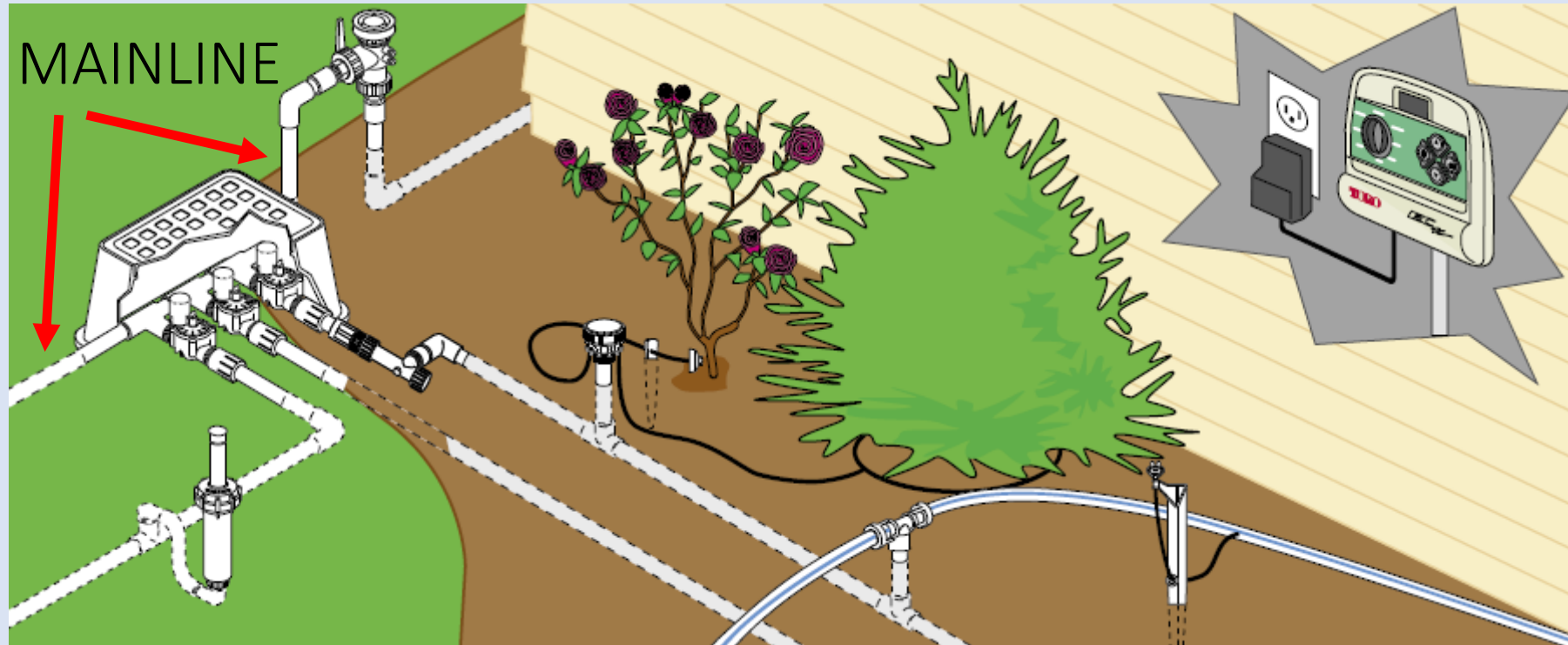
Thank you!

Brad Jakubowski
brj8@psu.edu

**Troubleshooting Irrigation Using Sight,
Sound, and Smell? and Maybe a Shovel Too**

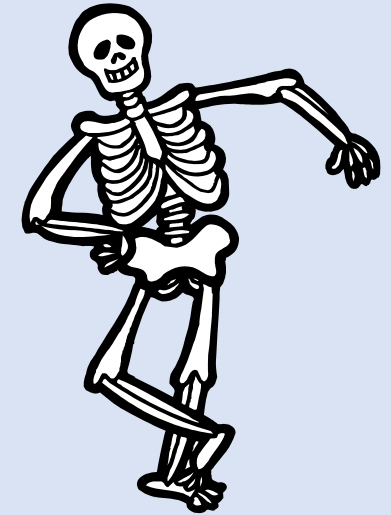
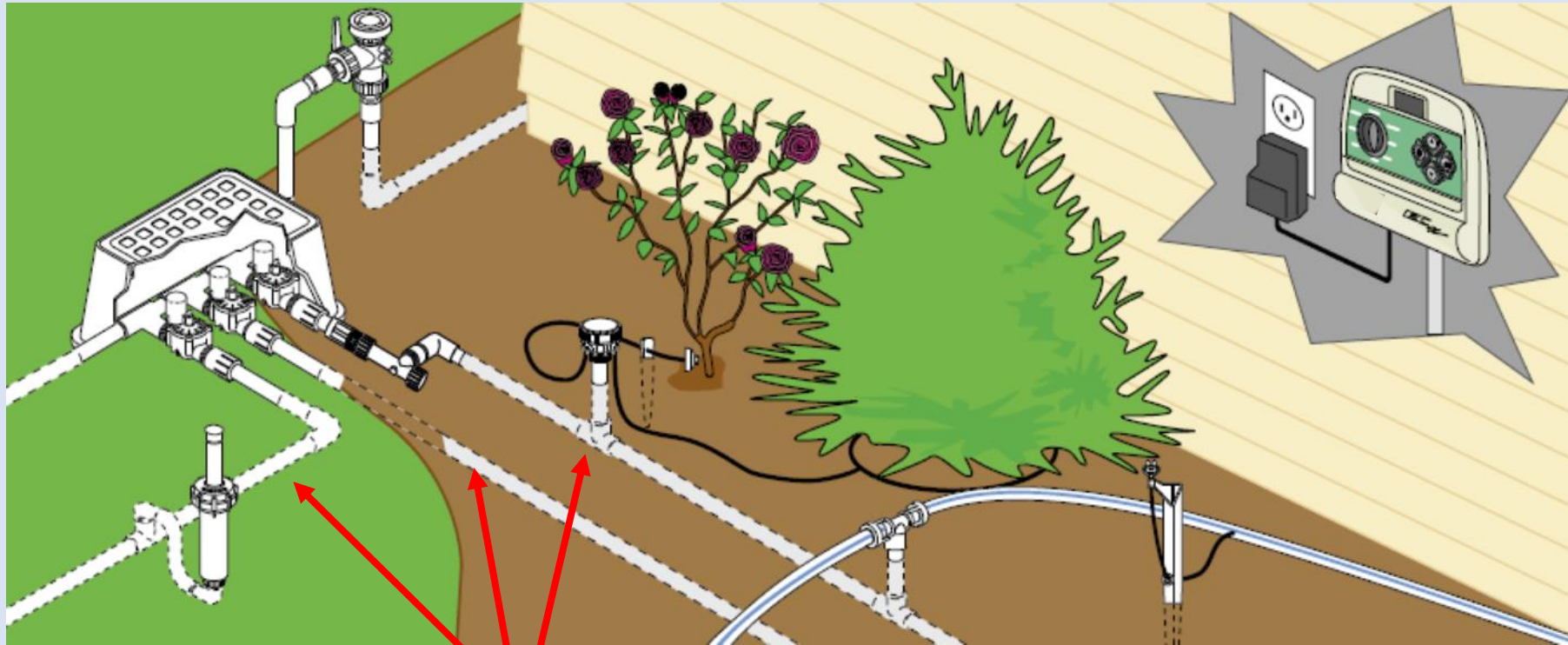


Piping and Sprinklers – Arms, Legs, Fingers, Toes



Pipe usually **under constant pressure** which supplies water from the point of connection to the control valves

Lateral Line



LATERAL LINE

pipe running from the control valve to the sprinklers **not under constant pressure.**

