

A to Z – Pumps and Controls

2019 Northeast Onsite
Wastewater Short
Course



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NOWRA
National Onsite Wastewater
Recycling Association

Pumps Overview

- Converts mechanical energy into hydraulic energy
 - energy is needed to overcome the limitations of gravity
 - energy is needed to achieve a flow or volume of liquid movement

There are Many Pumps

- centrifugal
- turbine
- submerged
- positive displace
- suction-end
- self priming
- rotary
- grinder
- well
- peristaltic
- jet pumps
- self-priming
- sewage
- sump

So,

- We need to ask questions
 - what is our application
 - where is our application
 - what is the pump's purpose

What is our Application

- Raw sewage
 - must be able to handle solids
 - must be able to handle stringy materials
- Septic tank effluent
 - very minimal solids
- Look for label on pump that indicates “effluent or sewage”

Where is our Application

- Typically, Submersed in One Nasty Environment
 - very corrosive atmosphere above the water line
 - pump materials must not degrade in the liquid and gas of the our pump chamber
 - electrical connections must not short to water

What is the Pump's Purpose

- High flow, low pressure
 - typical of pump-to-gravity system
 - LPP or LPD
- Low flow, high pressure
 - subsurface drip
- or something in between



Once you know the Style of Pump

- The appropriate pump is selected based on
 - Flow
 - Pressure
 - sometimes called ‘head’
 - **BUT NOT** on horsepower
 - horsepower is the result of flow & pressure

Pump Capacity

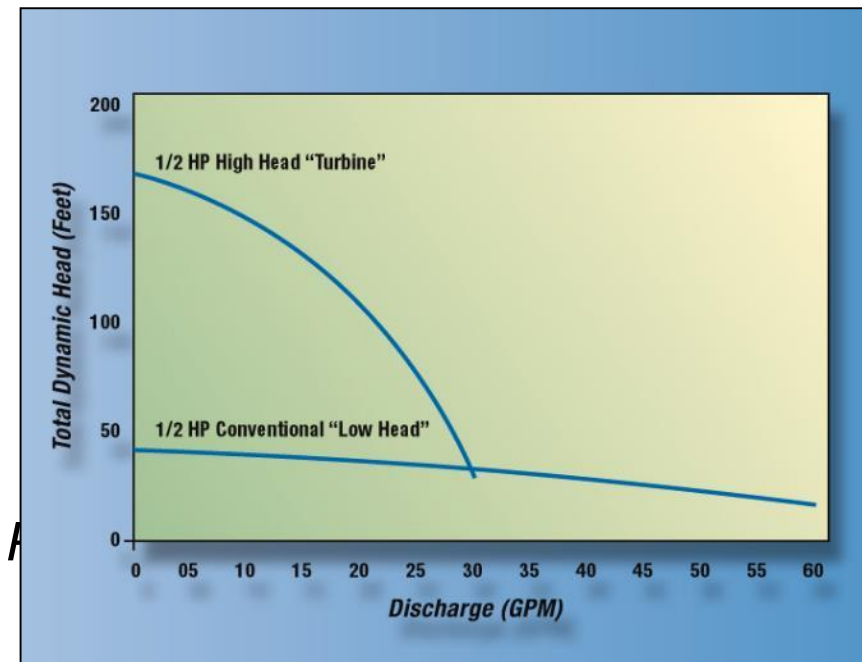
- Flow
 - rate that water needs to be moved
- Pressure (or head)
 - the pressure required to generate the required flow
 - calculated by knowing
 - elevation difference
 - friction in pipes and fittings
 - required pressure at distal end

Pump Curve

- Demonstrates the unique relationship between flow and pressure for a given pump
 - all pumps have a pump curve

Using a Pump Curve

- One-half horsepower
 - the turbine pump can produce high head at low flows
 - the other pump cannot produce much head but has high flow
 - notice the curve shape



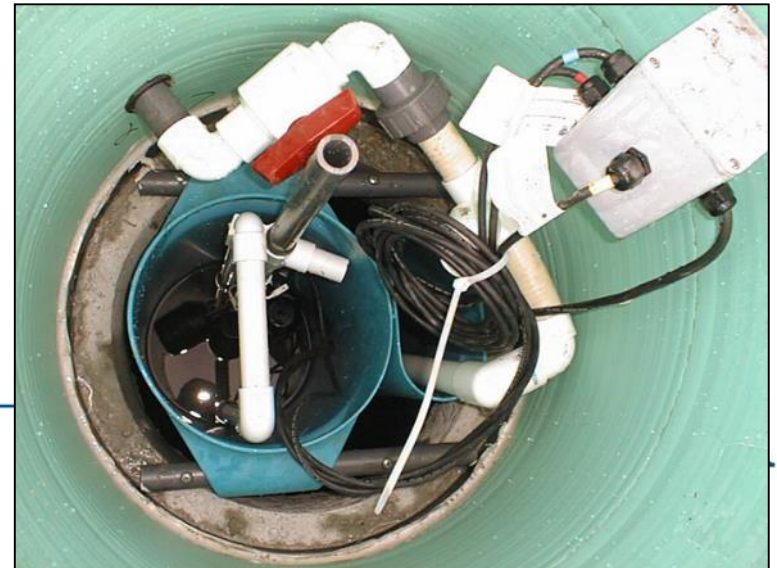
Pump Placement

- Pump must be up out of the solids layer
 - unless it is a grinder pump
- A block is common
 - but not recommended
 - hard to find when tank is full of sewage
 - pump torque will move pump
 - no screen



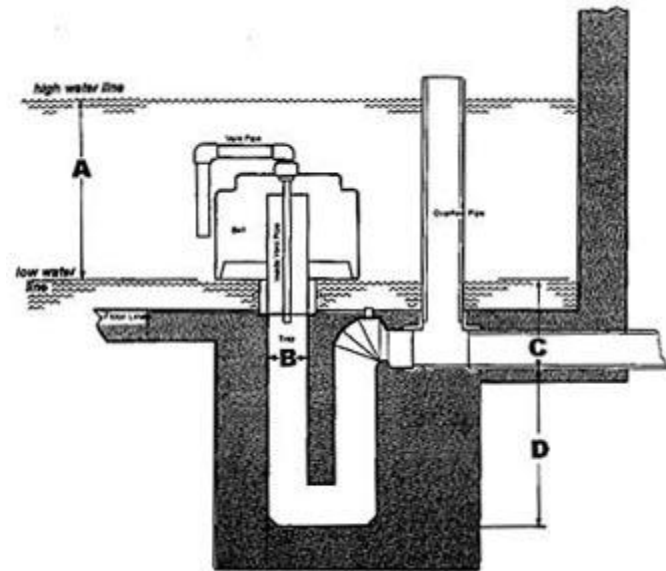
Better Technology

- Pump vaults
 - supports pump off tank bottom
 - provides solids screening
 - provides easy access
 - easy float placement



Self Priming Siphon Valve

- Does not provide pressure
- Provides flow and volume
 - gravity is needed to form the siphon
 - volume is determined by the placement of the air inlet



Controls Overview

- A control feature can be as simple
 - as a valve, weir or orifice
 - a float switch turning on or off a pump, blower, or alarm
- With additional sophistication, controls can
 - communicate problems
 - and record data

Control Scope

- The term “controls” includes those features of the system which:
 - Actively or passively dictate or “control” the operation
 - Provide information through visible signals, alerts, alarms or information transfer
 - Log/collect, display, and/or summarize overall system performance

Control Systems for Onsite Wastewater

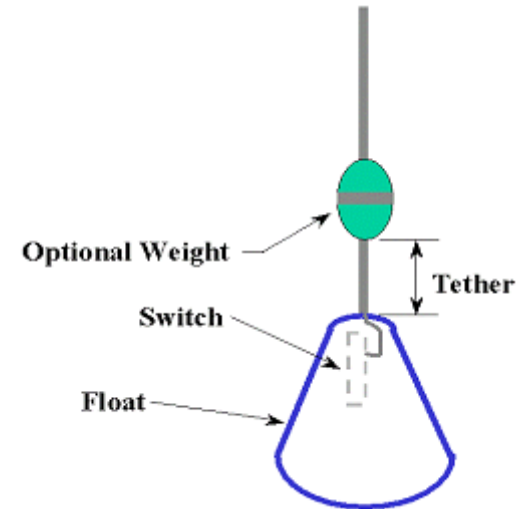
- Categories of control components
 - Sensors
 - floats
 - Logic
 - relays and computer boards
 - Communications
 - alarms and telemetry
 - Data collection
 - counters and timers

Overview

- Electro-Mechanical controls generally include three components
 - a sensing feature
 - a switching feature
 - a controlled device.

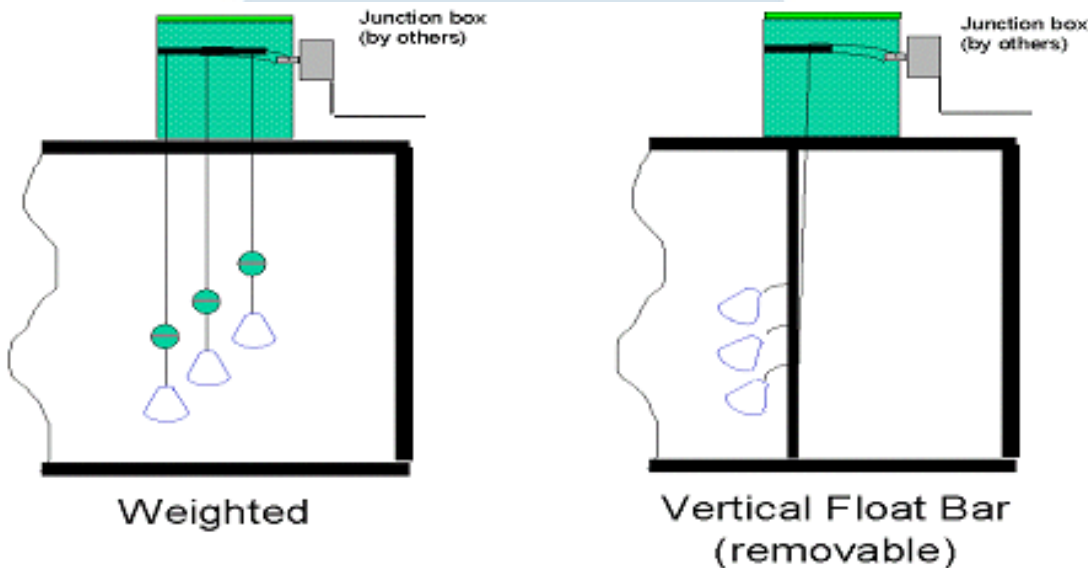
Components of a Simple Float Switch

- The float switch illustrated has a weight to allow it to be placed in a tank without the need to be attached to a vertical support



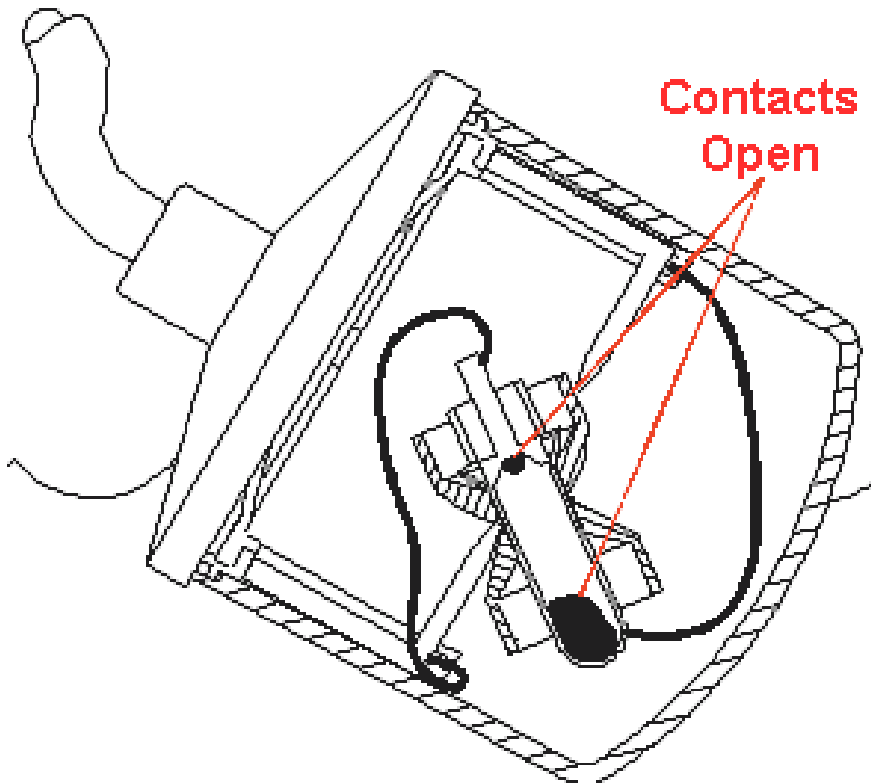
Weighted vs Tethered Floats

- weighted
 - connected up in the riser
- tethered
 - connected below water level

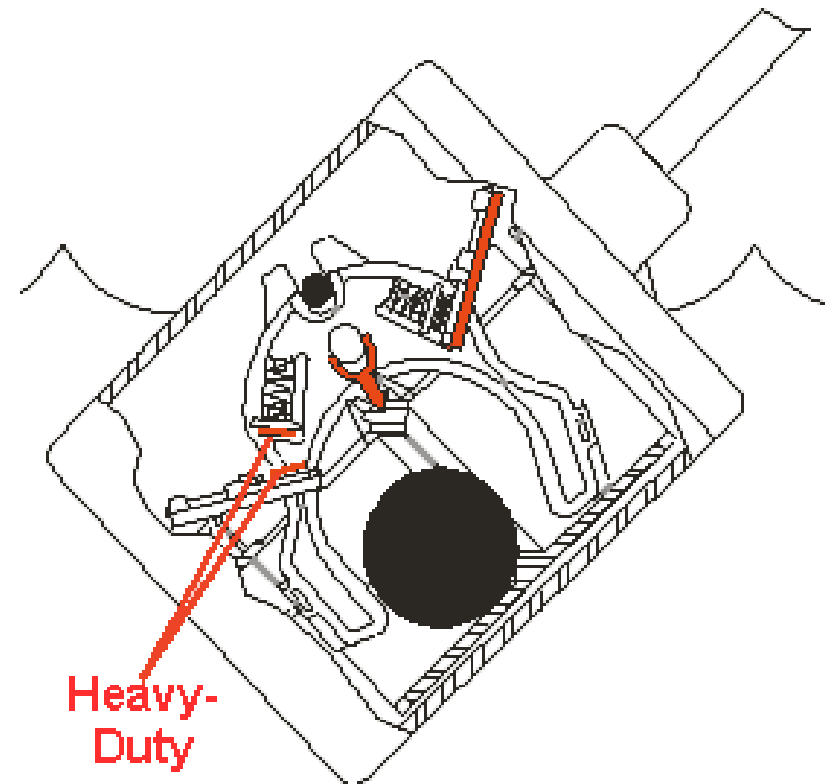


Mercury and Mechanical Float Switch

Mercury Float Switch

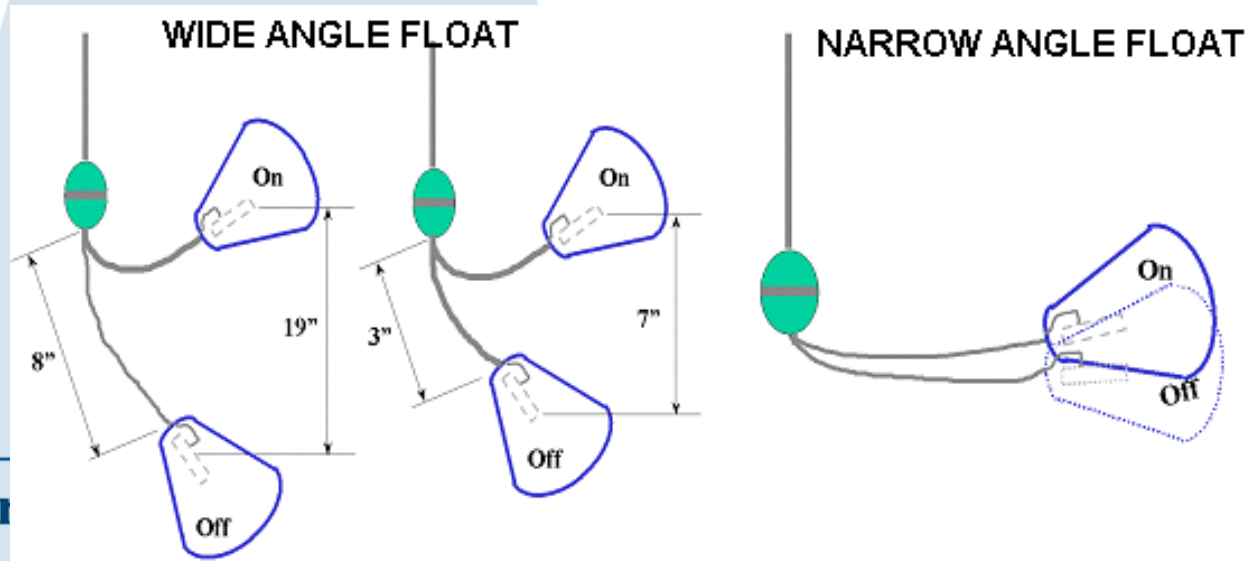


Mechanical Float Switch



Wide Angle and Narrow Angle Float Switches

- Float switches have differing activation angles
 - Narrow angle
 - Wide angle



Normal Position

- Normal position for floats is hanging down
 - normally open floats
 - contacts are open in normal position and closed in non-normal position
 - normally closed floats
 - contacts are closed in normal position and open in non-normal position

Two Ways to Control Doses

- Demand dosing
- Timed dosing

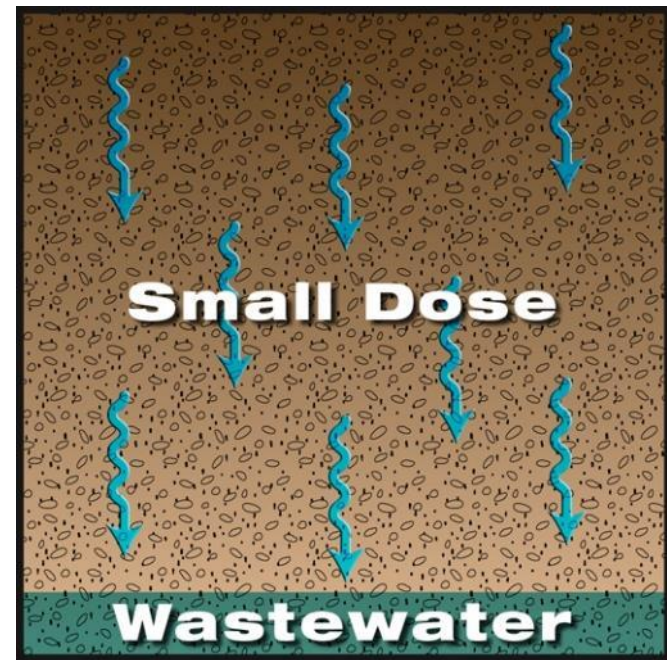
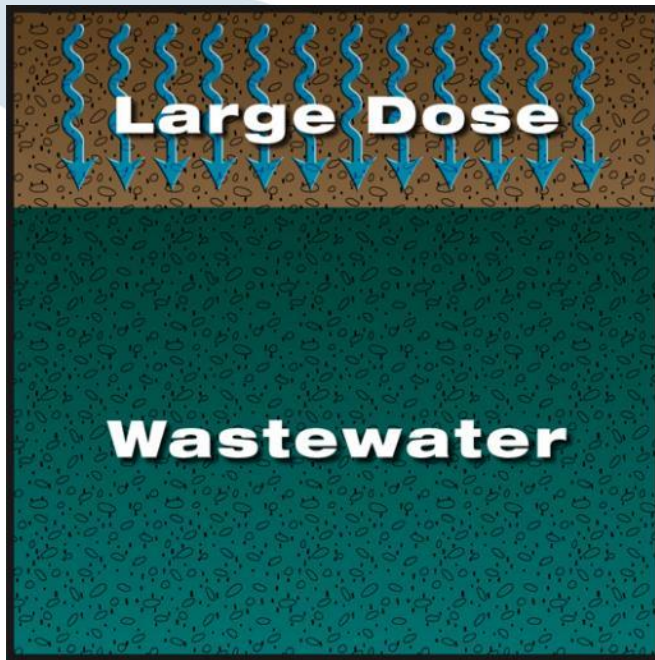
Timed Dosing

- The pump runs when
 - The float is in the on position and the timer is activated
 - Timed dosing takes advantage of the surge volume in the tank
 - provides a constant volume per dose and set the dose frequency

Demand Dosing

- The pump runs from the “on” to the “off” positions
 - The pump runs when water is present to activate the float
 - The dose volume varies if water enters the basin during the pump cycle
 - The dose volume depends on the float tether length

Effect of A Large Dose in the Drainfield

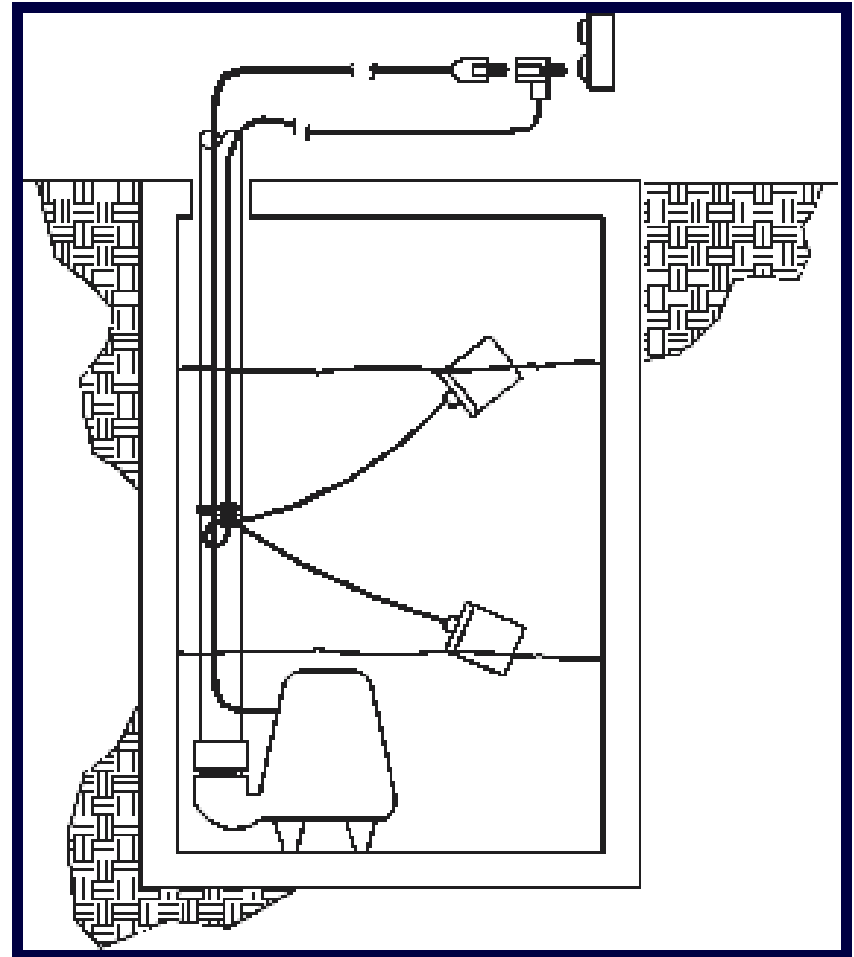


Large dose fills all of the voids
in the trench, eventually
clogging
and surfacing

People Caring About Water

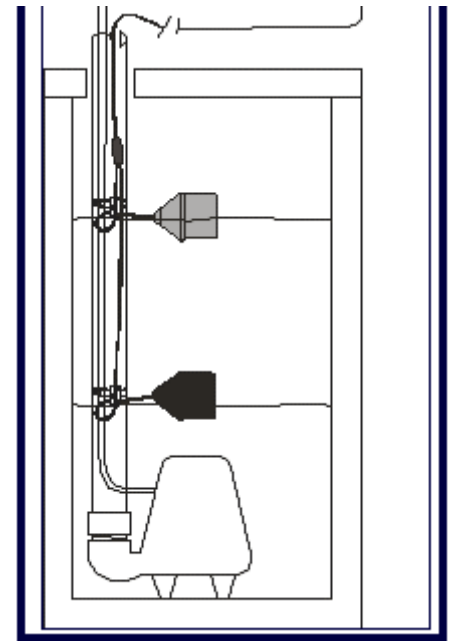
Demand Dosing With Floats: Single Float System

- Only use this arrangement in a small transfer tank and then be careful with cycling
 - piggyback switch should only be used indoors
 - never would be better



Demand Dosing With Floats: Two Float System

- Top float will close the circuit with rising water while the bottom float will open the circuit with falling water
- Requires a switching relay



Preferred Float Arrangement

- Use at least three floats in the system
 - High water alarm
 - On/off
 - Redundant off
- This will require a control panel... sort of
 - but it is a good investment
- My favorite float arrangement
 - High water
 - On float
 - Off float

Demand Dosing With Floats: Three & Four Float System

- Additional floats enable
 - High water alarms
 - Redundant pump off
 - Low-water alarm signaling the pump chamber is running dry and pump may burn out.

High Water Alarm Float

- Used to signal if the water level rises above the “on” level
 - Can be used to activate an audible/visible alarm
 - Can also be used as an override
 - Should have storage above it in the tank

Redundant Off Float

- Used as a pump “fail safe”
 - Turns the pump (or timer) off when the liquid level reaches this point.
 - Activates a low level alarm
 - Prevents the pump from running dry
 - Other floats can fail or get hung up

Float Cords

- Don't cut them off to shorten
 - You will need the length to remove them from the basin during service
 - You can wrap them up and stow them neatly in the riser and out of the way
 - Order enough cable to traverse from tank to control panel without splice

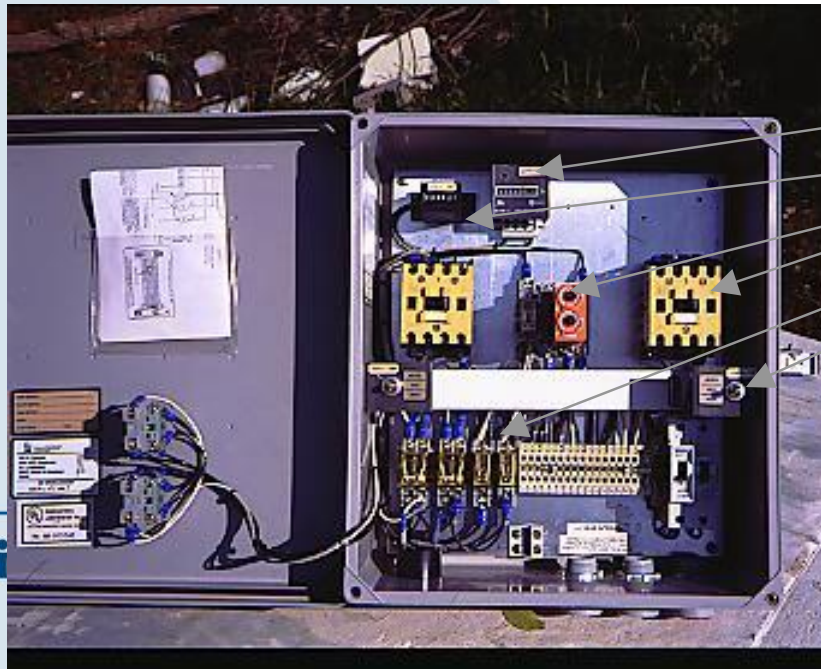
Introduction to Panels

- Range from
 - simple on-off-alarm panels
 - to programmable timers, elapsed time meters, event counters,
 - and to data acquisition modules, programmer interfaces and even telemetry interfaces



Controls and Control Panels Come With a Variety of Capabilities

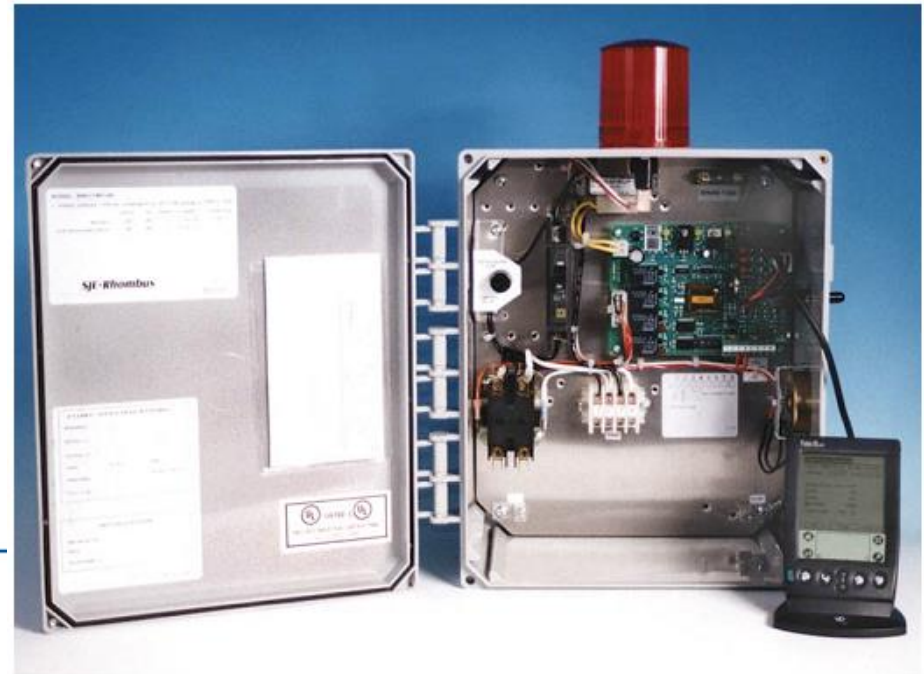
- The technologies illustrated in this panel are common in a wide range of industrial applications



EVENT COUNTER
ELAPSED TIME CLOCK
ADJUSTABLE TIMER
MOTOR CONTROLLER
RELAYS
MANUAL SWITCH

Digital Control Panel With PDA Data Acquisition

- Newer technology panels can have additional capabilities due the rapid advancements in electronics and computer technology



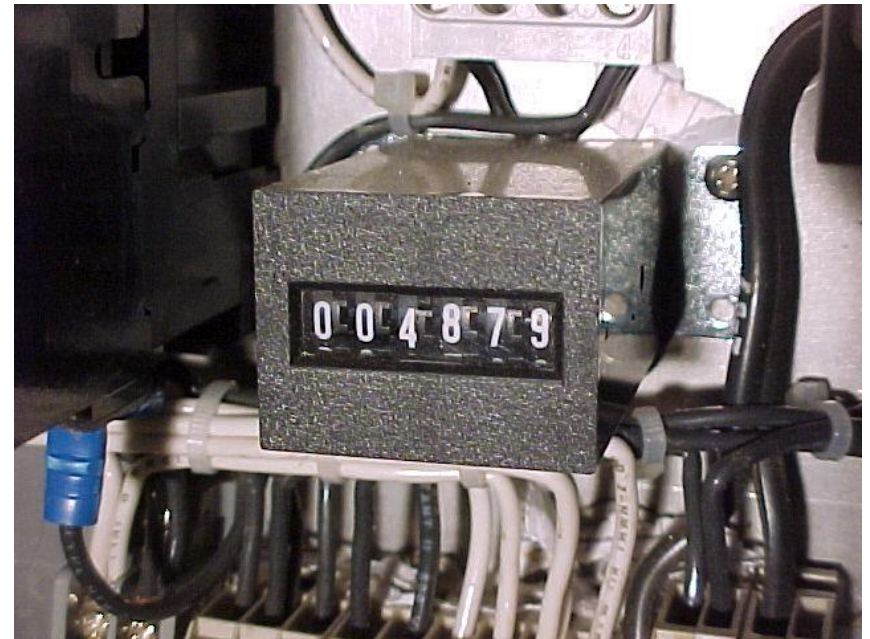
Elapsed Time Meter

- The elapsed time meter reveals the total amount of time that the pump has been running.
 - pump's flow rate multiplied by the elapsed time to determine the total effluent discharged



Event Counter

- Event counters will register each time the pump is turned on
 - determine number of dose between service visits



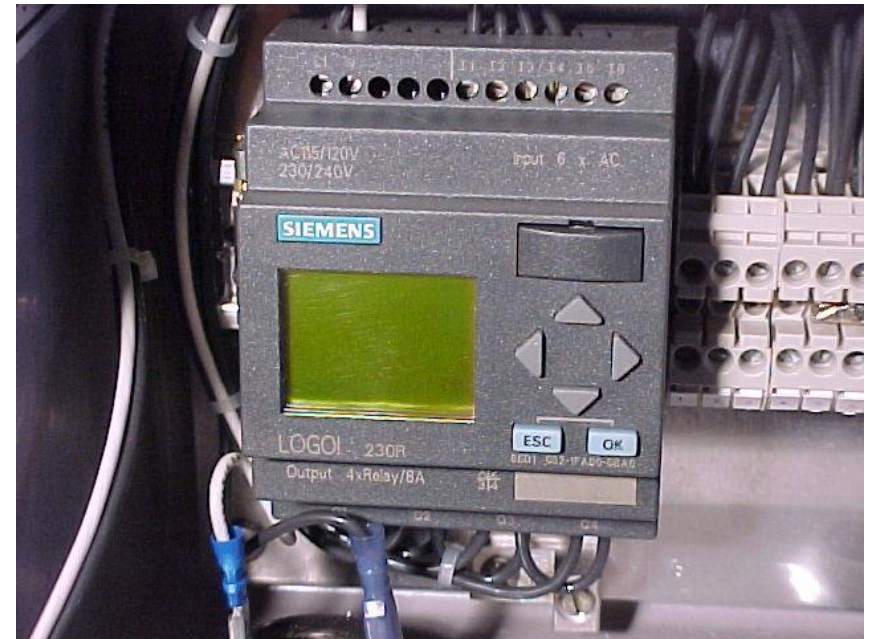
Analogue Programmable Timer

- Mechanical timers and schedulers to control an onsite system



Digital Programmable Timer

- Programmable controller
 - can enter parameters on the screen
 - or with laptop computer with appropriate software



Control Panels for System Management

- Panels are available
 - which will dial out over a phone line to send alert messages to management entities.
 - which will interface with a variety of hand held data devices

Why Does My Control Panel Look Scorched?

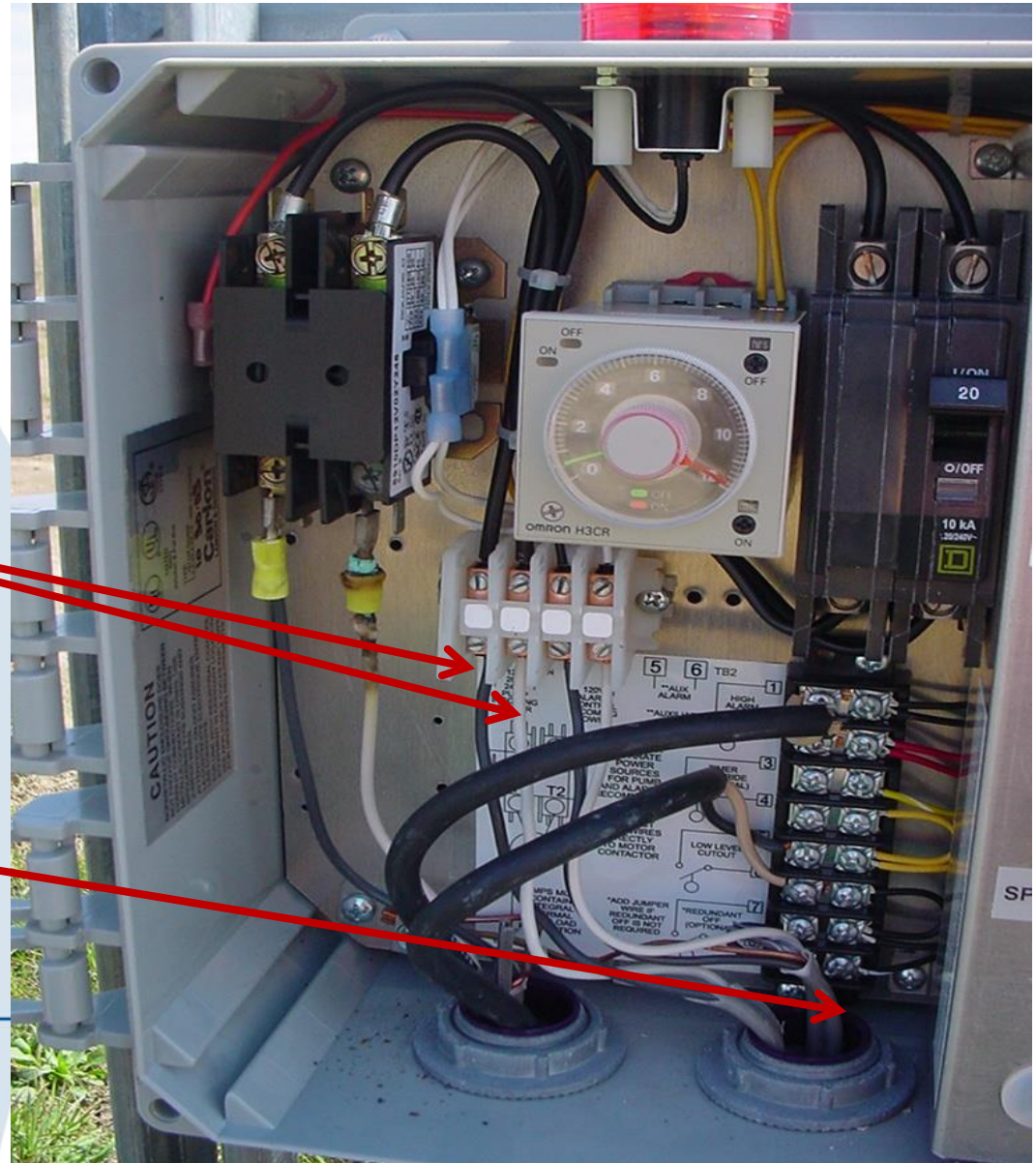
- Even if the splice box is watertight, it may not be gastight
 - Septic tanks can generate corrosive gases
 - Corrosive gases can move through the splice box, up the conduit and into the control panel
 - A simple conduit seal can prevent this problem

Basic Time Dose Control Panel

*Incoming
power to the
pump*

*Usually 12/2 UF
wire*

People Caring About Water

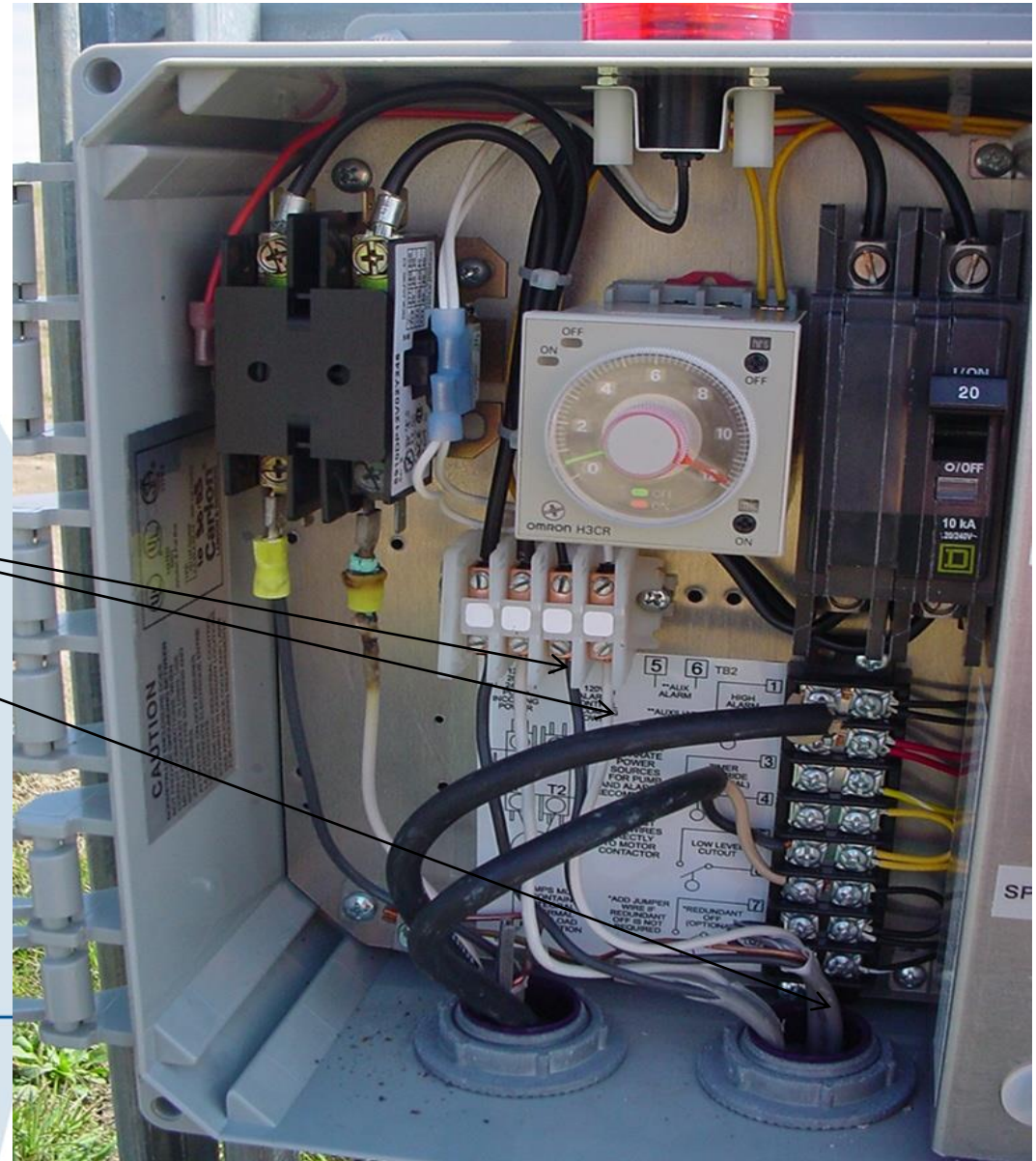


Basic Time Dose Control Panel

*Incoming power to
the panel*

*Usually a smaller
gauge wire like
14/2 UF*

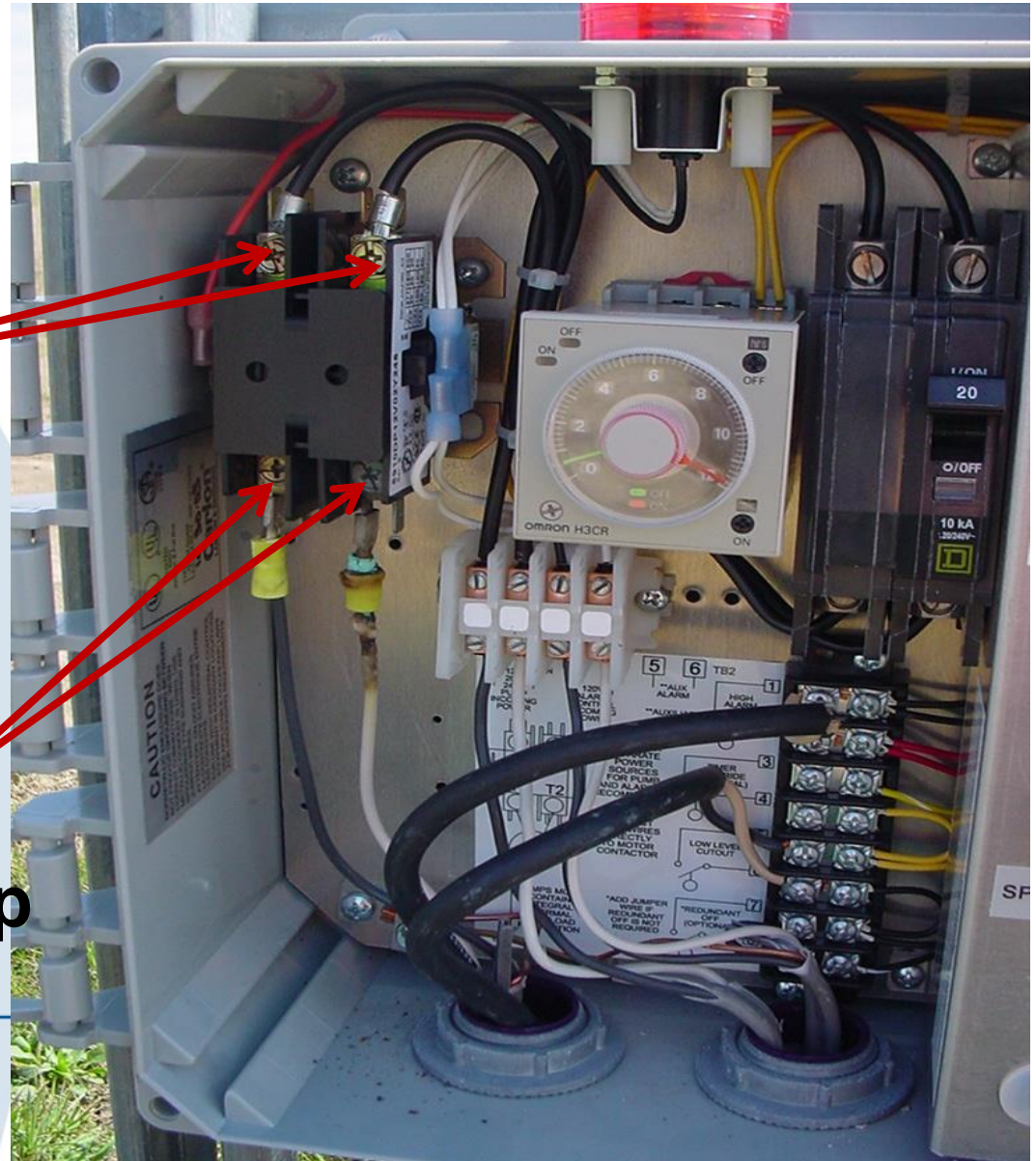
People Caring About Water



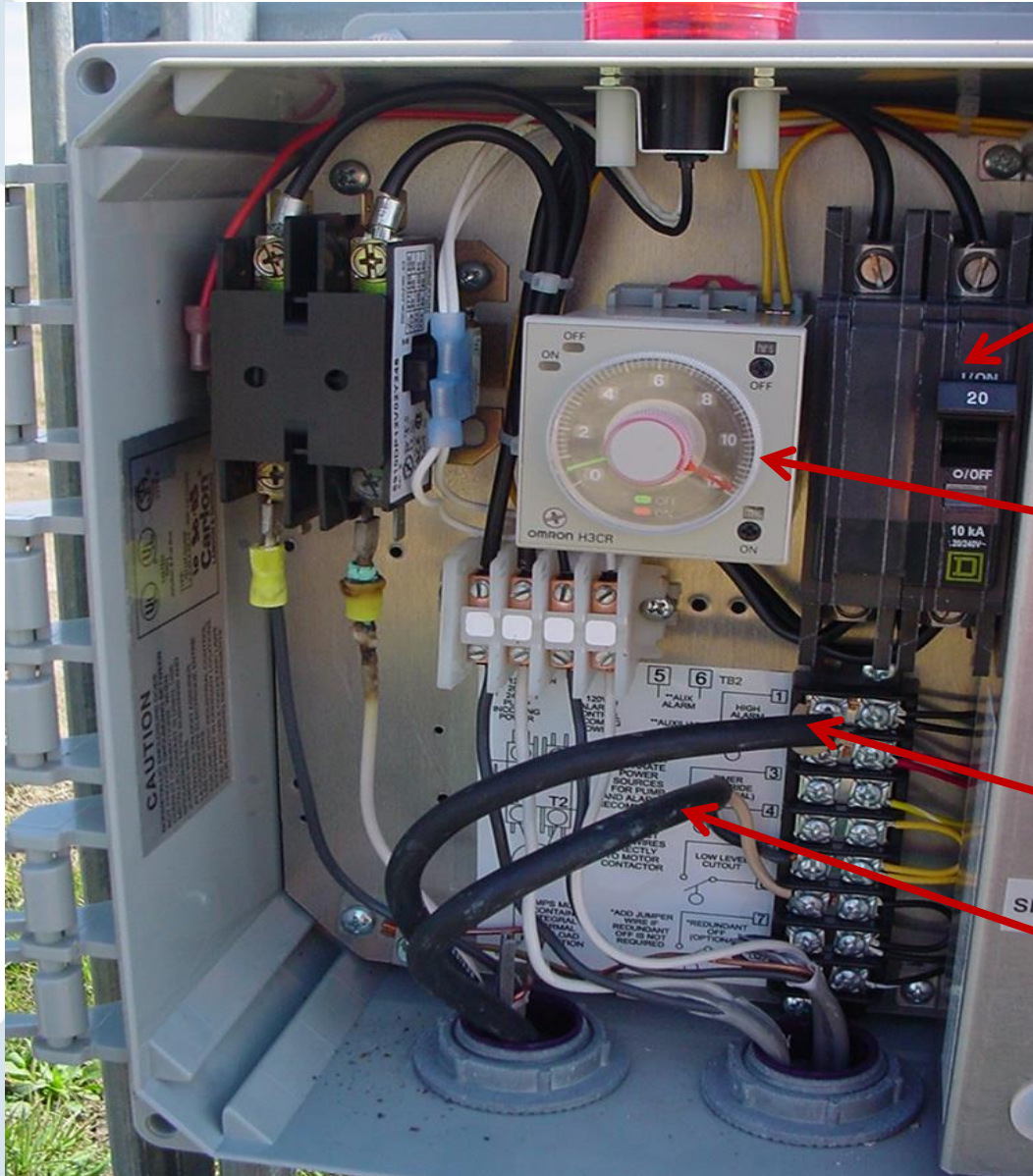
Basic Time Dose Control Panel

Pump power
to the relay

Pump power from
the relay to the pump



Basic Time Dose Control Panel



20 Amp breaker

Timer

High water alarm float

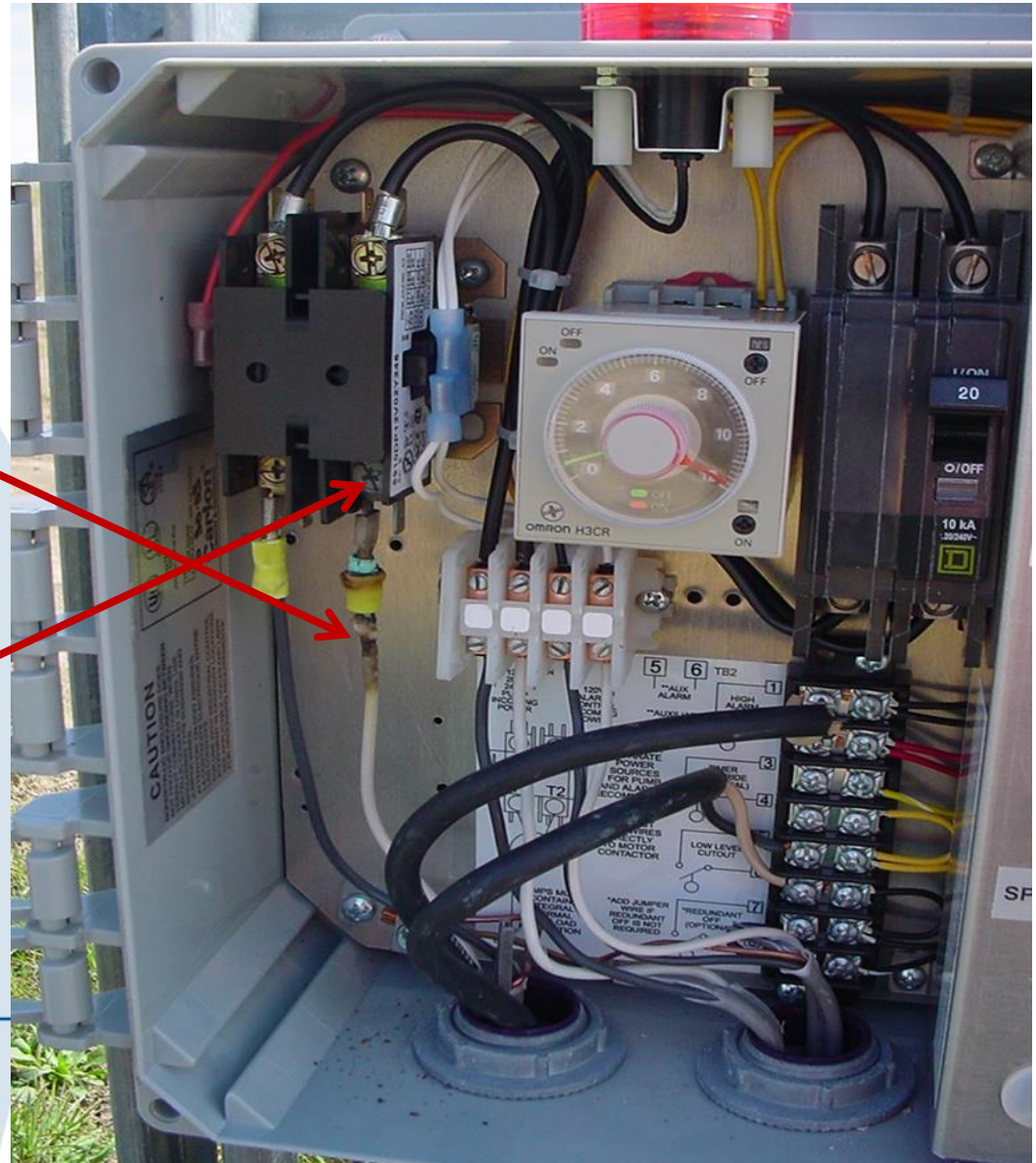
Low level cut off float

Basic Time Dose Control Panel

Did anybody notice this ?

What could be the cause ?

Probably this

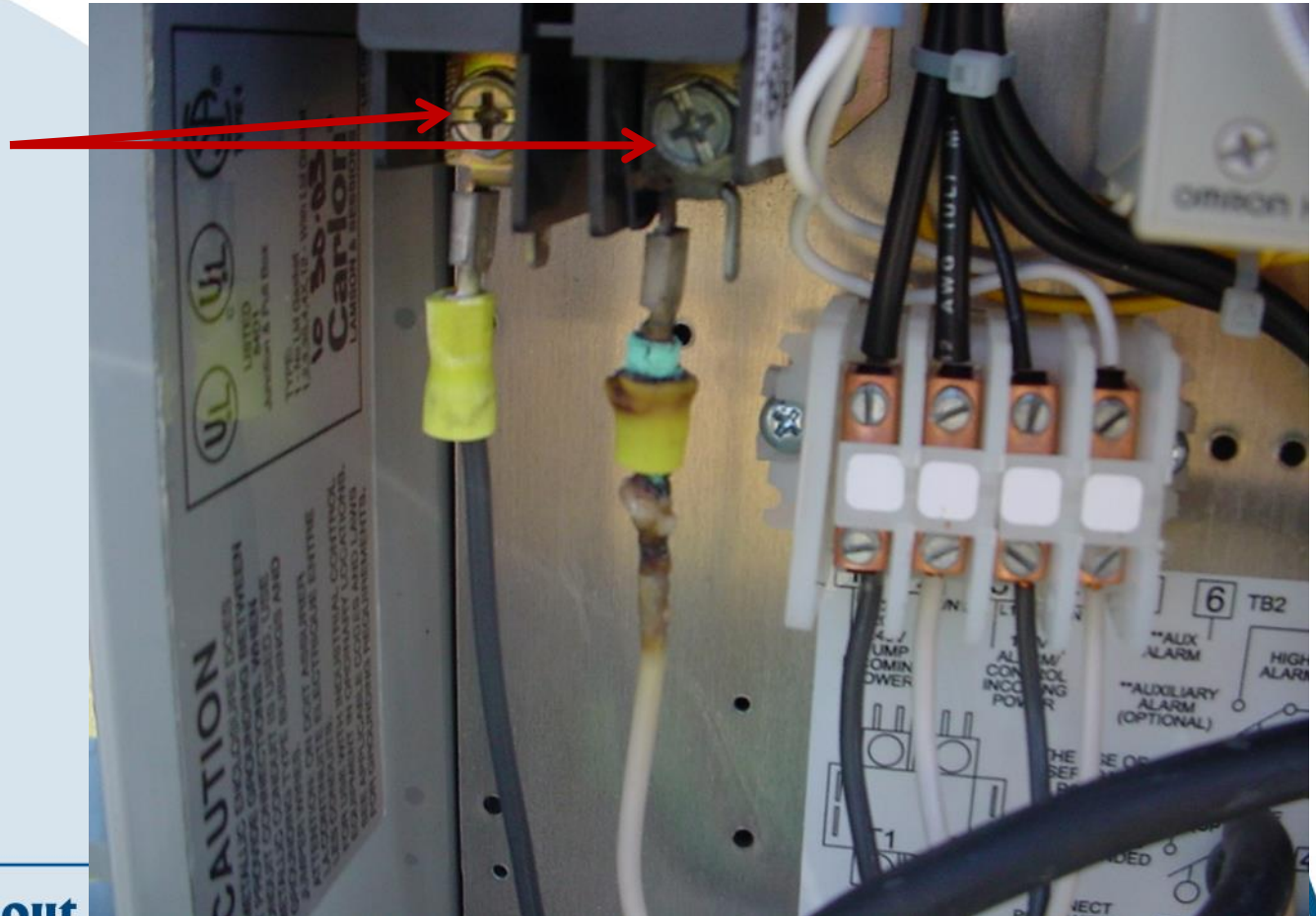


People Caring About Water

Basic Time Dose Control Panel

Notice the difference in the color of the brass lug screws ?

This is from the heat caused by the loose connection

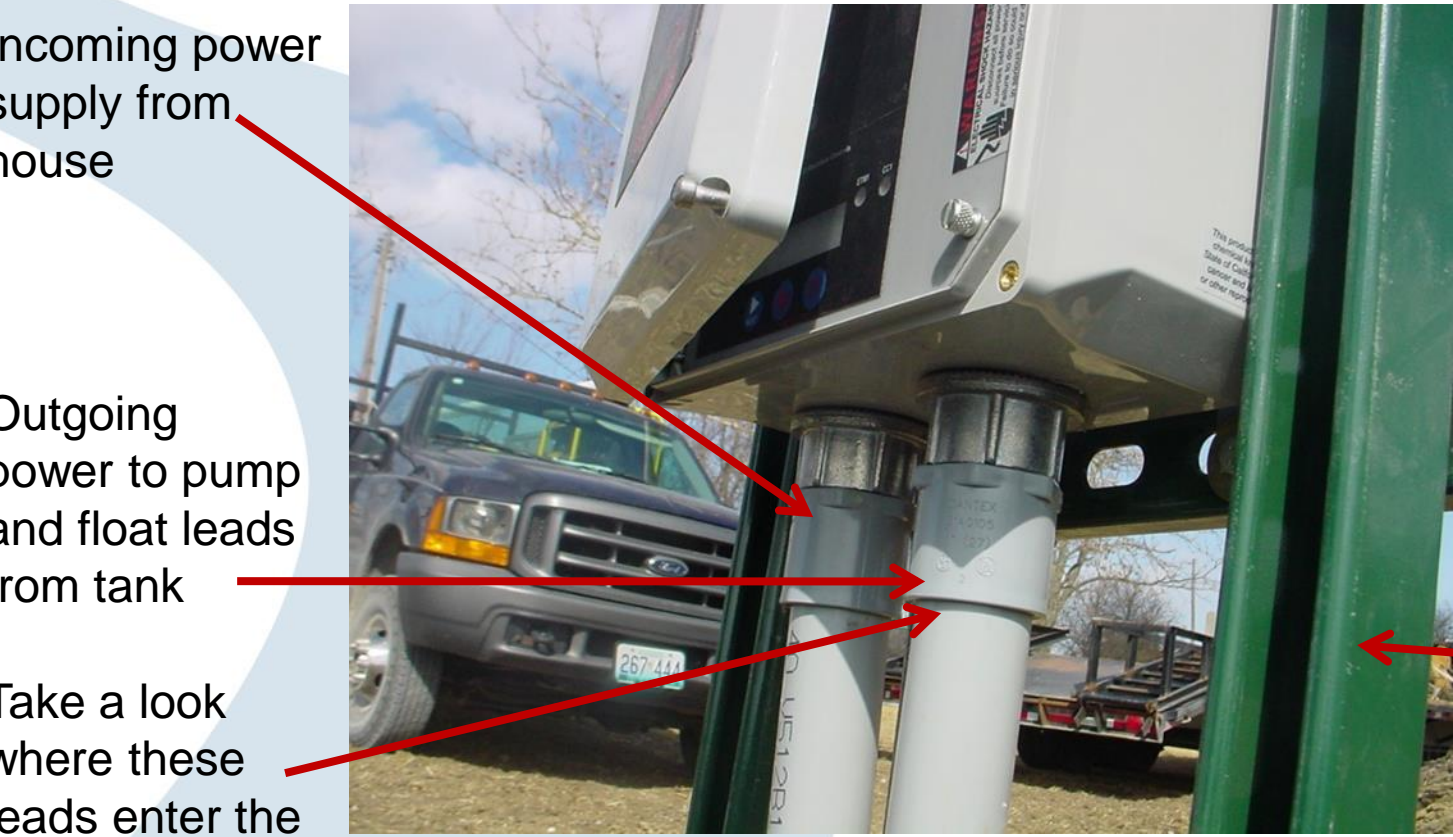


Conduit Seals



People Caring About Water

Basic Time Dose Control Panel



Incoming power supply from house

Outgoing power to pump and float leads from tank

Take a look where these leads enter the tank

Panel mounted on sturdy unistrut extending along side the tank to a depth of 5 feet minimum

Note: All leads are in conduit attached to the panel with watertight hubs and penetrating the panel in the bottom maintaining the NEMA 4 rating

Basic Time Dose Control Panel



Power to pump and float leads maintaining good watertight connections from the panel to the tank

IMPORTANT: Don't forget to seal the tank gasses from the panel

Basic Time Dose Control Panel

Ready
for
backfill



Electrical Connections



People Caring About Water

Not Like This



People Caring About Water

Or Even Like This

- No splices should be open to atmosphere of tank
 - this is not acceptable



Or this



People Caring About Water

Could Electrocute the Owner

- And yourself



People Caring About Water

Piggyback Plug

- Just say no



Risers and Watertight Tanks

- If you have a pump in the tank, there must be a riser and a riser lid for access to service the pump

Risers and Penetrations

- The riser connection to the tank should be watertight
- The riser lid should be secure

Green Grass during Drought

- Concluding Thought
 - Build the system as if it is going to last for the life of the home



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QUESTIONS ?