BASIC ELECTRICAL THEORY & TROUBLESHOOTING
SAFETY IS THE MOST IMPORTANT THING. ELECTRICITY CAN KILL YOU!
• VOLTAGE ALWAYS FOLLOWS THE PATH OF LEAST RESISTANCE
• IT TAKES LESS THAN 1 AMP OF CURRENT TO STOP YOUR HEART
ALWAYS TURN OFF POWER WHEN WORKING INSIDE A CONTROL PANEL, OR ON ANY OTHER ELECTRICAL DEVICE
• TURN OFF THE SERVICE BREAKER FEEDING THE CONTROL PANEL OR ELECTRICAL DEVICE, USUALLY LOCATED OUTSIDE OF THE CONTROL PANEL.

• TURNING OFF THE BREAKERS IN THE CONTROL PANEL ONLY KILLS POWER TO THE COMPONENTS DOWN STREAM OF THE BREAKER – THERE IS STILL POWER TO THE TOP OF THE BREAKERS AND ANYTHING BEFORE IT IN THE CIRCUIT.
OKAY – LET’S GET STARTED!!!
WE CAN THINK OF ELECTRICITY IN TERMS OF WATER BEING PUMPED THROUGH A SERIES OF PIPES

- **VOLTAGE** is the pressure being produced by the pump, think of this as H.P.
- **CURRENT (AMPS)** is the flow rate, how fast the water flows through the pipes. Think of this as GAL/MIN
- **OHMS** is the resistance that acts on the water. The more restrictions the higher the resistance.
COMMON ELECTRICAL TERMS

- VOLTAGE (VOLTS)
- CURRENT (AMPS)
- RESISTANCE (OHMS)
- POWER (WATTS)
DIGITAL VOLT METER – AN INSTALLERS/ELECTRICIAN’S BEST FRIEND!

- **VOLTS A/C** (HOME/CONTROLS/ALARMS)
- **VOLTS D/C** (CARS, SOME CONTROLS, ETC)
- **OHMS** (RESISTANCE)
- **AMPS** (CURRENT)
- (+) **POSITIVE LEAD** (RED) WHEN READING AMPS
- (-) **NEGATIVE LEAD** (BLACK)
SCHEMATICS 101
IT’S NOT AS TOUGH AS YOU THINK
READING A SCHEMATIC

• READING A SCHEMATIC IS LIKE READING A ROAD MAP

• FIND YOUR STARTING POINT AND DESTINATION, THEN FOLLOW THE MAP.

• USE YOUR METER TO CHECK CIRCUITS ON THE WAY

• IT’S OKAY TO ASK FOR DIRECTIONS IF YOU GET LOST
TROUBLESHOOTING 101

EVEN EASIER THAN READING A SCHEMATIC
Troubleshooting Basics

A pumping station has 4 basic elements:

1. Electrical Service
   - must match motor rated voltage
   - measure with meters

2. Control panel
   Control circuit
   - check for voltage at terminals
   - check for blown fuses
   - run pumps manually with HOA switch
   - simulate float sequence
   Pump circuit
   - check voltage
   - tripped circuit breakers
   - check contactor or overload unit

3. Floats
   - disconnect at least one lead and check with ohmmeter

4. Motor
   - disconnect leads and check with ohmmeter
TROUBLESHOOTING A FLOAT

- **CHECKING RESISTANCE (OHMS) DOESN’T ALWAYS TELL THE TALE.**
- **TO GET THE WHOLE STORY YOU MUST CHECK VOLTAGE ACROSS THE FLOAT, THIS IS ESPECIALLY TRUE WHEN IT COMES TO MECHANICAL FLOATS.**
- **IN A CONTROL PANEL THE PUMP ON/OFF FLOATS ARE POWERED BY THE CONTROL CIRCUIT.**
- **WHEN CHECKING VOLTAGE YOU MUST BE SURE OF WHAT YOUR CONTROL VOLTAGE SHOULD BE, I.E. 12VDC, 24VDC, 120VAC (THIS CAN BE FOUND ON THE CONTROL PANEL RATINGS LABEL).**
Pump Switches
Pump Switches

Pump Switch
QUESTIONS?
• THE CONTROL/ALARM CIRCUIT SENDS POWER TO THE FLOATS.

• THE CONTROL/ALARM CIRCUIT POWERS THE MOTOR CONTACTOR COIL, ALL THE LIGHTS, AND THE BEACON & HORN.

• THE CONTROL/ALARM CIRCUIT IS SEPARATE ELECTRICALLY FROM THE PUMP CIRCUIT.
• RED LEAD GOES TO FIRST FLOAT CONNECTION (NON-SWITCHED SIDE)
• BLACK LEAD GOES TO NEUTRAL AND STAYS THERE
• MEASURE VOLTAGE, IF IT IS PRESENT MOVE THE RED LEAD DOWN TO THE NEXT TERMINAL FOR THAT SAME FLOAT. LIFT THE FLOAT AND SEE IF THE SAME VOLTAGE IS PRESENT.
- Secure bottom float in the up (closed position)
- Leave the black lead on neutral
- Red lead goes to non-switched side of second float, check voltage
- If voltage is present, raise second float and hold it, move red lead to the next terminal of that float (switched side)
CHECKING CONTROL/ALARM VOLTAGE IN A CONTROL PANEL

- Put meter to volts A/C
- Connect black lead to “COM” terminal & red lead to “V” terminal
- Put red lead to incoming power terminal (L1)
- Put black lead to neutral terminal (N). Should be 120VAC
- LOCATE THE MOTOR CONTACTOR AND IDENTIFY THE COIL CONNECTIONS (USUALLY LABELED A1 AND A2). SET METER TO VOLTS A/C
- RED LEAD GOES TO ONE COIL CONNECTION.
- BLACK LEAD GOES TO THE OTHER COIL CONNECTION
- PUT HOA SWITCH TO HAND AND WATCH TO SEE IF YOU HAVE VOLTAGE. IF YOU DO BUT THE CONTACTOR DOES NOT PULL IN THE CONTACTOR IS BAD, IF YOU DON’T HAVE VOLTAGE CHECK CONNECTIONS AND FUSES.
IN THIS EXAMPLE THE PUMP WILL NOT RUN IN HAND OR AUTO, CONTACTOR DOES NOT PULL IN. PUMP DOES RUN WHEN CONTACTOR IS PUSHED IN MANUALLY.

STEP 1: PLACE HOA SWITCH TO “OFF”, CHECK INCOMING VOLTAGE FOR CONTROL ALARM CIRCUIT

STEP 2: CHECK FUSES AND CIRCUIT BREAKERS

STEP 3: PLACE HOA SWITCH TO “HAND”

STEP 4: CHECK VOLTAGE AT MOTOR CONTACTOR COIL
Alarm Circuit Troubleshooting

Alarm does not work.

Depress test switch... Does alarm sound?

- **YES**
  - Disconnect all voltage. Tag and remove alarm float.
  - Secure jumper wire in place of alarm float. Reconnect voltage and turn power on. Alarm should sound.
  - **YES**
    - Call Factory
  - **NO**
    - Float may be incorrectly installed or failed.

- **NO**
  - Verify incoming alarm voltage with volt meter.
  - **YES**
    - Turn off incoming power and check fuse.
  - **YES**
    - Call Factory
QUESTIONS?
CHECKING INCOMING PUMP VOLTAGE

• PUT METER TO VOLTS A/C
• CONNECT BLACK LEAD TO “COM” AND RED LEAD TO “V” ON YOUR METER
• PUT RED LEAD TO L1 TERMINAL IN CONTROL PANEL
• PUT BLACK LEAD TO “L2” TERMINAL FOR 230VAC PUMPS, OR “N” TERMINAL FOR 120VAC PUMPS IN CONTROL PANEL
IN THIS EXAMPLE OUR PUMP WILL NOT RUN IN HAND OR AUTO, CONTACTOR DOES PULL IN.

STEP 1: WITH THE HOA SWITCH IN THE “OFF” POSITION WE CAN START BY CHECKING INCOMING POWER

STEP 2: CHECK VOLTAGE AT THE NEXT STOP (CIRCUIT BREAKER), CHECK BOTH THE TOP AND BOTTOM.

STEP 3: PUT THE HOA SWITCH TO “HAND” AND CHECK VOLTAGE ON EACH SIDE OF THE MOTOR CONTACTOR CONTACTS, FIRST THE TOP, THEN THE BOTTOM.

STEP 4: CHECK VOLTAGE AT THE PUMP CONNECTIONS.
TROUBLESHOOTING A PUMP CIRCUIT

• PUT PUMP HOA SWITCH INTO “HAND” AND CONFIRM THAT THE CONTACTOR IS PULLING IN – YOU SHOULD HEAR AN AUDIBLE “CLUNK”. IF SO, PROCEED TO NEXT STEP – IF NOT CHECK VOLTAGE THROUGH THE CONTROL CIRCUIT (COULD BE A BAD M.C. COIL).

• CHECK VOLTAGE AT THE MOTOR CONNECTIONS IN THE PANEL – IF NO VOLTAGE TURN HOA TO “OFF” AND PROCEED TO NEXT STEP.

• CHECK PUMP INCOMING VOLTAGE – IT SHOULD MATCH PUMP RATED VOLTAGE. IF YES THEN PROCEED TO THE NEXT STEP.
TROUBLESHOOTING A PUMP CIRCUIT CONT.

• IF THERE IS A CIRCUIT BREAKER IN THE PANEL FOR THE PUMP CONFIRM THAT IT IS TURNED ON – NOT TRIPPED.

• CHECK VOLTAGE ON BOTH SIDES OF THE CIRCUIT BREAKER.

• CHECK VOLTAGE AT THE TOP (LINE SIDE) OF THE MOTOR CONTACTOR.

• PUT HOA INTO HAND AND CHECK VOLTAGE ON BOTTOM (LOAD SIDE) OF THE MOTOR CONTACTOR. IF NO REPLACE CONTACTOR, IF YES PROCEED TO NEXT STEP.

• CHECK VOLTAGE AT MOTOR CONNECTION TERMINAL BLOCK.
TROUBLESHOOTING A MOTOR CIRCUIT

PUMP DOES NOT RUN

PUT HOA SWITCH TO HAND…. DOES CONTACTOR PULL IN

YES

IS VOLTAGE PRESENT AT PUMP CONNECTION

YES

HAVE PUMP CHECKED

NO

CHECK VOLTAGE THROUGH PUMP CIRCUIT

BAD MOTOR CONTACTOR – CALL FACTORY

NO

CHECK CONTROL VOLTAGE AND CONTROL FUSE

YES – BOTH GOOD

CHECK VOLTAGE AT MOTOR CONTACTOR COIL

REPLACE FUSE OR CHECK INCOMING POWER SOURCE

NO

CHECK VOLTAGE THROUGH CONTROL CIRCUIT
QUESTIONS?
THANK YOU