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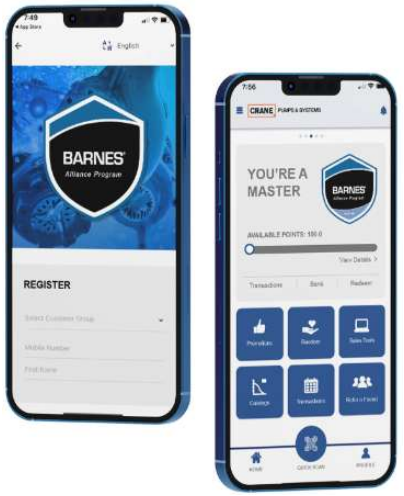

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Effluent Pump Power & Electrical Wiring

PASEO Onsite Wastewater Super Conference
February 3rd 2025

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Disclaimer

This presentation is for informational purposes only. Always consult with licensed professionals for electrical installations and adhere to local codes and regulations provided by governing authorities. The content provided here does not constitute professional advice or guidance.

Agenda

- Safety Overview
- Electrical Wiring Basic Components
- Wiring best practices
  - Determining correct wire gauge
  - NEMA Guidelines on Starts Per Hour
  - Grounding Procedures
- Troubleshooting Techniques
  - At The Panel
  - Capacitors
  - Level Control
  - Pump

Safety Overview

- De-energize the panel
  - Use redundancy when possible
    - Turn off service breaker as well as control panel breaker
    - Turn off control panel breaker, use lock out clip
- Avoid wet environments if possible
- Use insulated tools to avoid accidental shock

Pump 1 is De-Energized

Panel is De-Energized

Electrical Wiring Basic Components

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Control Panel

Capacitor

Level Control Float

Pump

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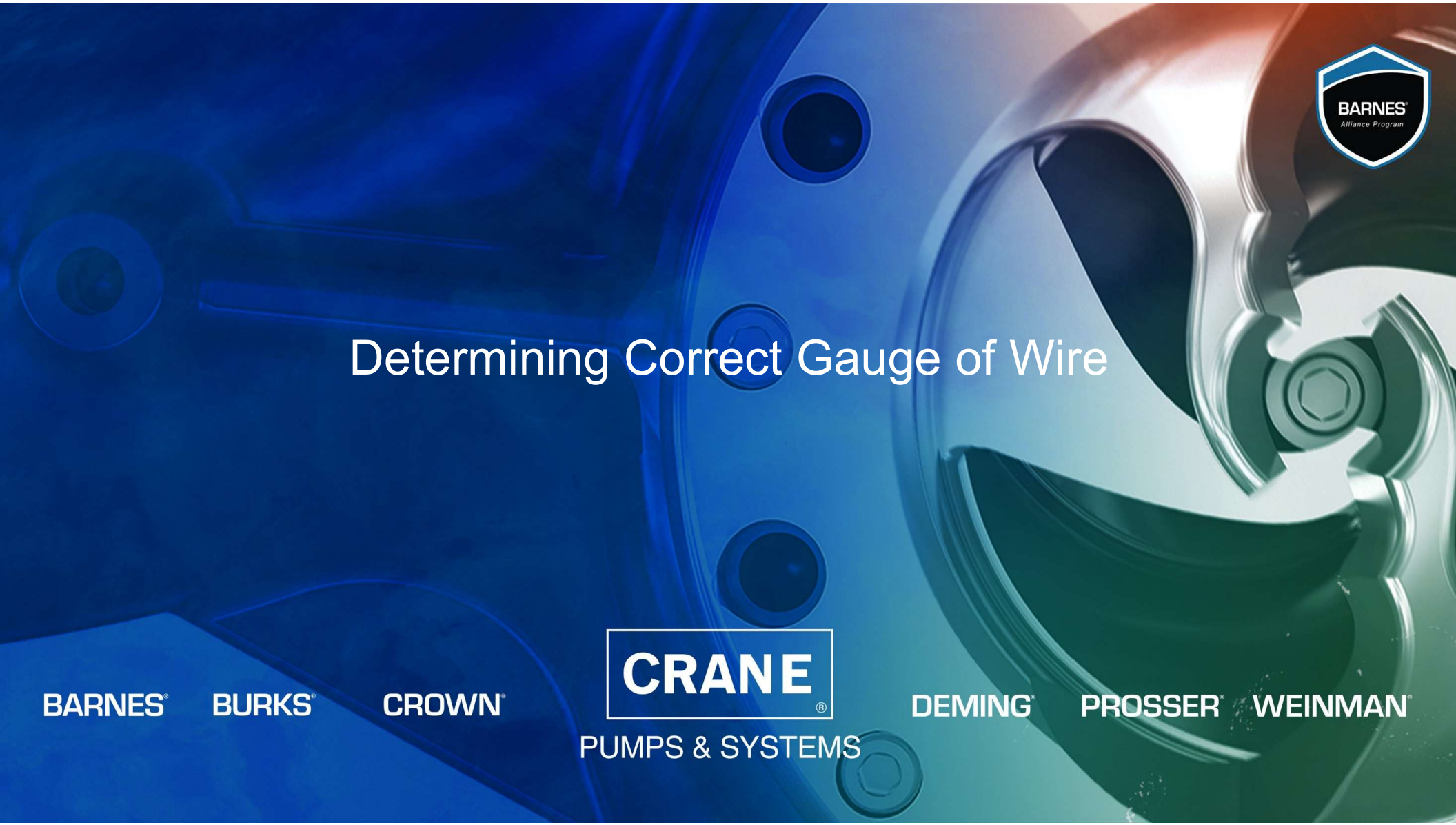
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Determining Correct Gauge of Wire
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Determining Correct Cord Gauge

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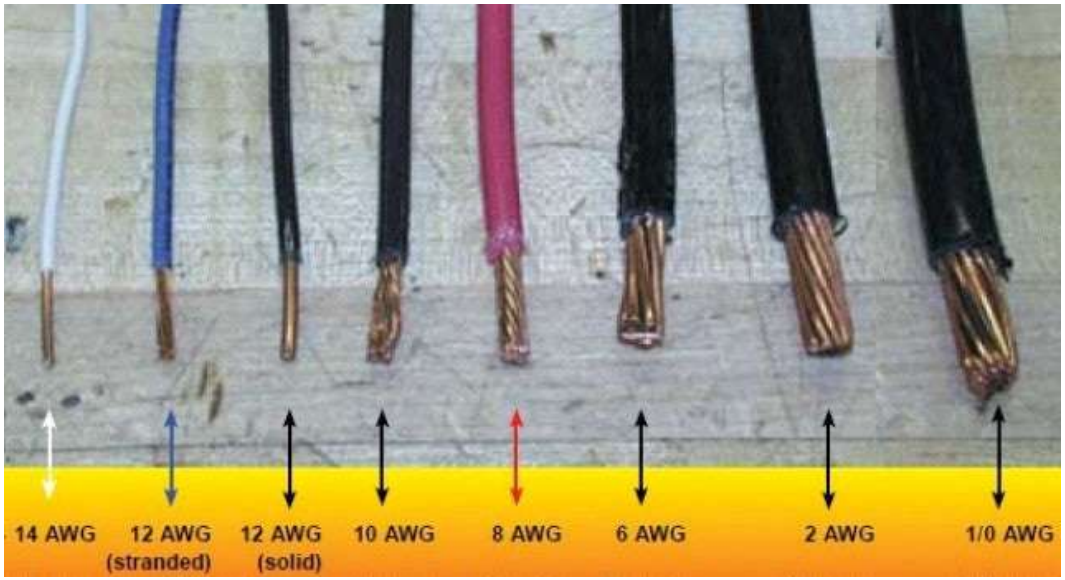
- Why is it important?
  - Using a Gauge of wire that's too large
    - Higher, unnecessary costs
    - Installation challenges
    - No improvement to performance or longevity
  - Using a gauge of wire that is too small
    - Overheating (fire risk)
    - Voltage drop for long runs
    - Premature equipment failure
    - Code Violations
    - Safety Violations



The National Electrical Code (NEC) mandates that overcurrent protection devices, such as circuit breakers, must not exceed the ampacity of the conductors they protect.
Nec Section 240.4(D)

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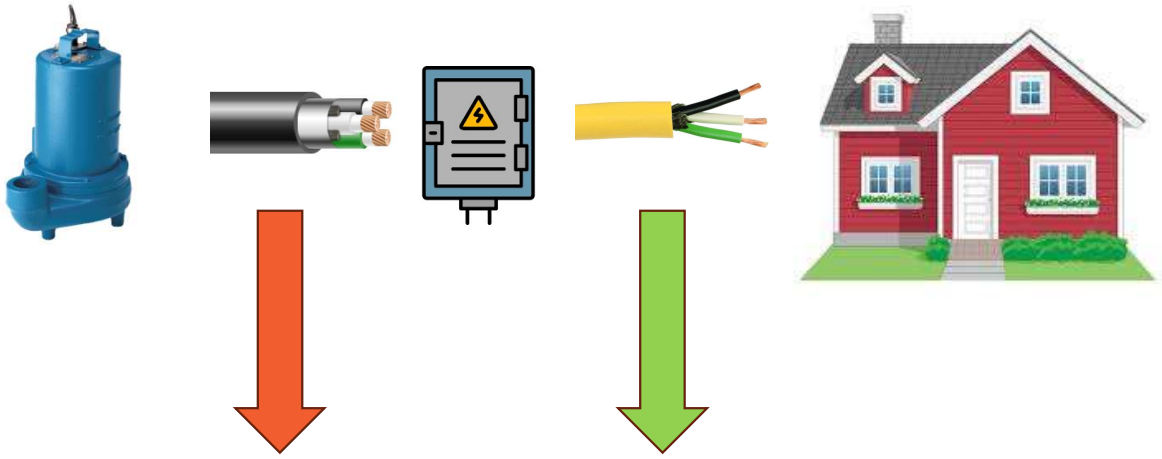
Determining Correct Cord Gauge: Contributing Factors

- Pump HP FLA
- Panel Breaker and/or fuses
- Wire length (Voltage Drop)
- Temperature Rating

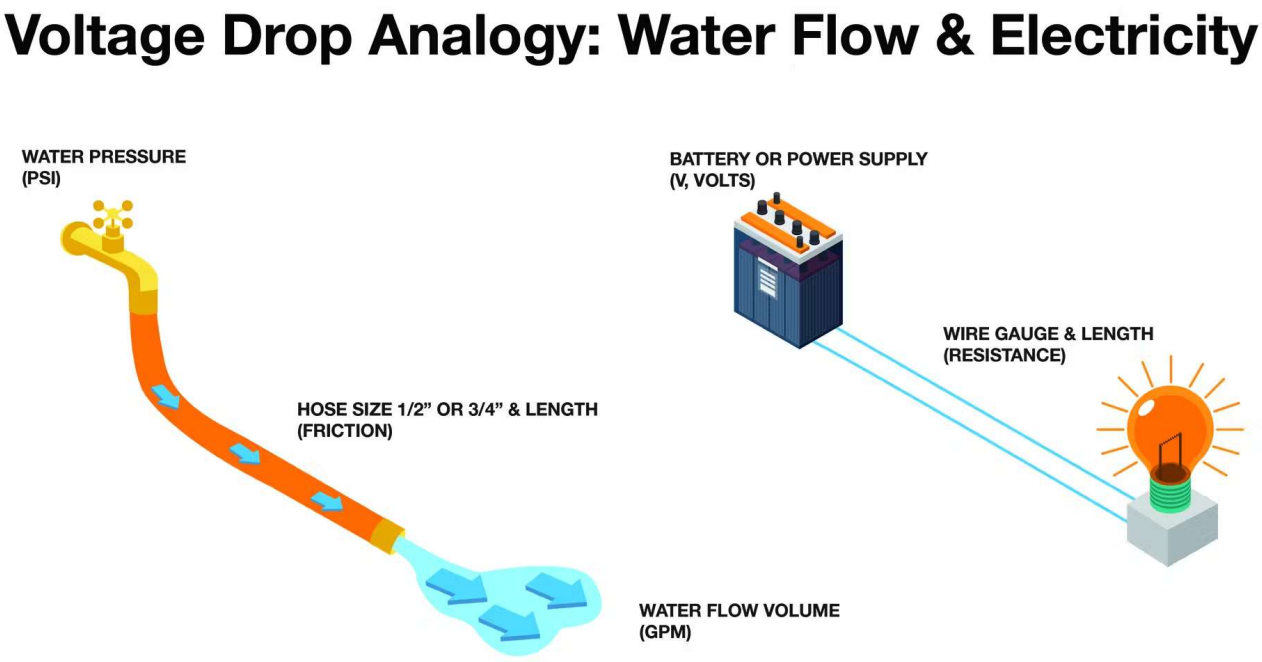


Use Power cords provided by supplier

Today's Focus

Determining Correct Cord Gauge: Voltage Drop

- Voltage Drop can be thought of like water flowing from a hose.
  - The longer the hose, the weaker the stream of water that flows out.
- Longer runs of wire may result in a high enough voltage drop that an increase in wire gauge is required.



Determining Correct Cord Guage: Examples

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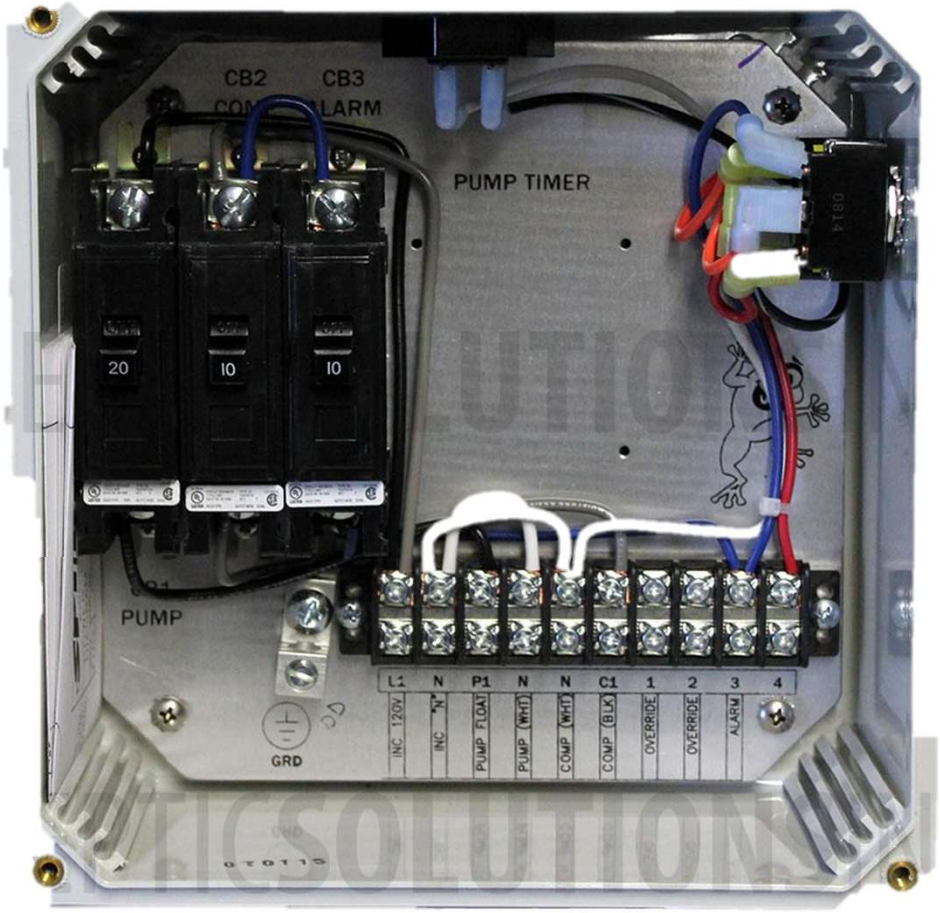
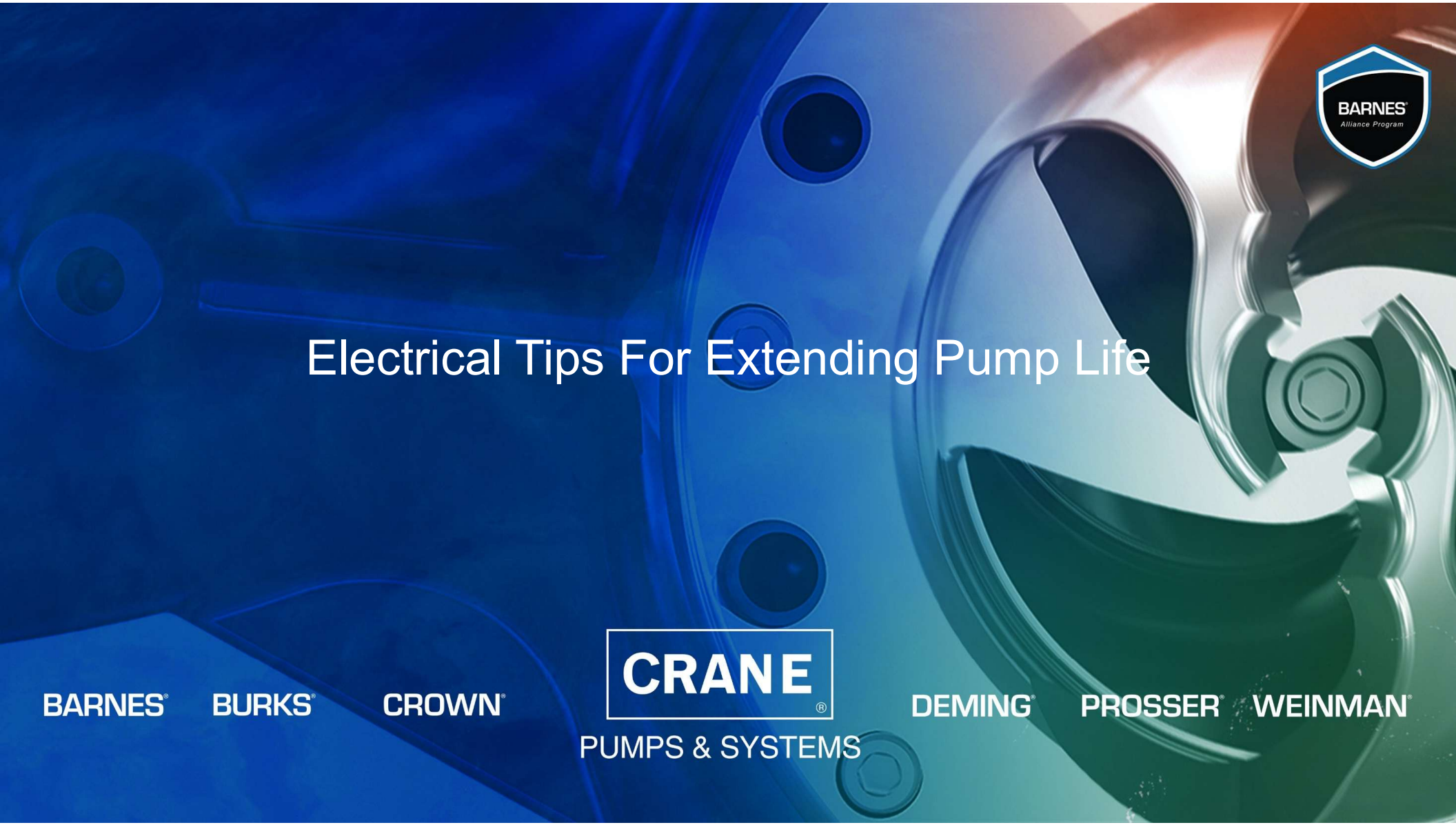
1/2 HP Effluent Pump
Voltage: 120V
FLA: 11.4 A



Wire AWG	Wire Length	Breaker (amps)
18 Copper	50’ or less	7
16 Copper	50’-100’	
16 Copper	50’ or less	10
14 Copper	50’-100’	
14 Copper	50’ or less	15
12 Copper	50’-100’	
12 Copper	50’ or less	20
10 Copper	50’-100’	
10 Copper	50’ or less	30
8 Copper	50’-100’	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Allowable Starts and Starting Intervals

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Controlling the number of cycles per hour for your pump will help maximize its life.

NEMA publishes recommendations design A and B motors starting at 1HP.

Consult with manufacturers on cycle/hour limitations on fractional HPs.

How To Get The Most From Your Electric Motors

Table 3. Allowable Starts And Starting Intervals (Design A and B Motors)

HP	2 Pole			4 Pole			6 Pole		
	A	B	C	A	B	C	A	B	C
1	15	1.2	75	30	5.8	38	34	15	33
1.5	12.9	1.8	76	25.7	8.6	38	29.1	23	34
2	11.5	2.4	77	23	11	39	26.1	30	35
3	9.9	3.5	80	19.8	17	40	22.4	44	36
5	8.1	5.7	83	16.3	27	42	18.4	71	37
7.5	7.0	8.3	88	13.9	39	44	15.8	104	39
10	6.2	11	92	12.5	51	46	14.2	137	41
15	5.4	16	100	10.7	75	50	12.1	200	44
20	4.8	21	110	9.6	99	55	10.9	262	48
25	4.4	26	115	8.8	122	58	10.0	324	51
30	4.1	31	120	8.2	144	60	9.3	384	53
40	3.7	40	130	7.4	189	65	8.4	503	57
50	3.4	49	145	6.8	232	72	7.7	620	64
60	3.2	58	170	6.3	275	85	7.2	735	75
75	2.9	71	180	5.8	338	90	6.6	904	79
100	2.6	92	220	5.2	441	110	5.9	1181	97
125	2.4	113	275	4.8	542	140	5.4	1452	120
150	2.2	133	320	4.5	640	160	5.1	1719	140
200	2.0	172	600	4.0	831	300	4.5	2238	265
250	1.8	210	1000	3.7	1017	500	4.2	2744	440

Where: A = Maximum number of starts per hour.
B = Maximum product of starts per hour times load Wk^2.
C = Minimum rest or off time in seconds between starts.
Allowable starts per hour is the lesser of (1) A or (2) B divided by the load Wk^2—i. e.,

Starts per hour $\leq A$ or $\leq B/Wk^2$, whichever is less.

Note: Table 3 is based on following conditions:

1. Applied voltage and frequency in accordance with MG 1-1998, 12.45.
2. During the accelerating period, the connected load torque is equal to or less than a torque which varies as the square of the speed and is equal to 100 percent of rated torque at rated speed.
3. External load Wk^2 equal to or less than the values listed in Column B.

For other conditions, consult the manufacturer.

Reference: NEMA Standards MG 10, Table 2-3.

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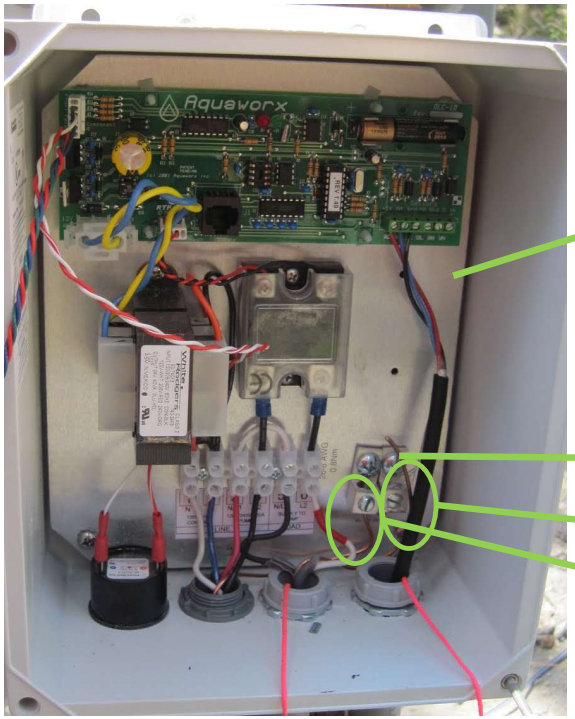
Wiring Best Practices: Grounding Procedures

- Grounding is intentionally creating a low-resistance path that connects a tool or electrical system to the earth.
- Ground requirement may vary based on whether you have a Metal or plastic enclosure

Plastic Enclosure



Grounding Plate

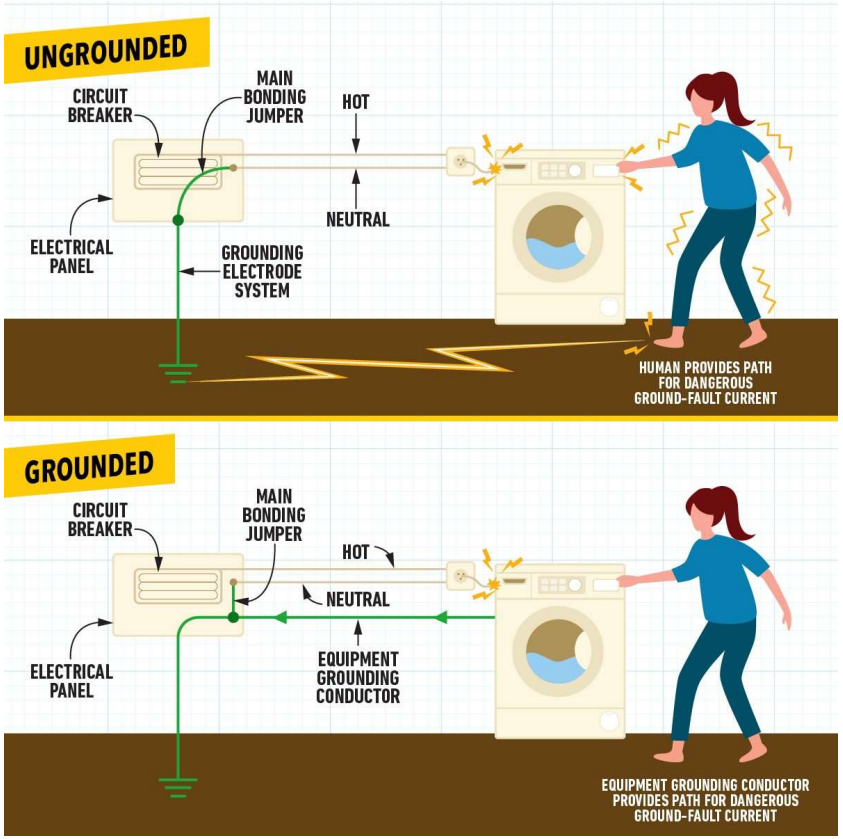
Grounding Lugs

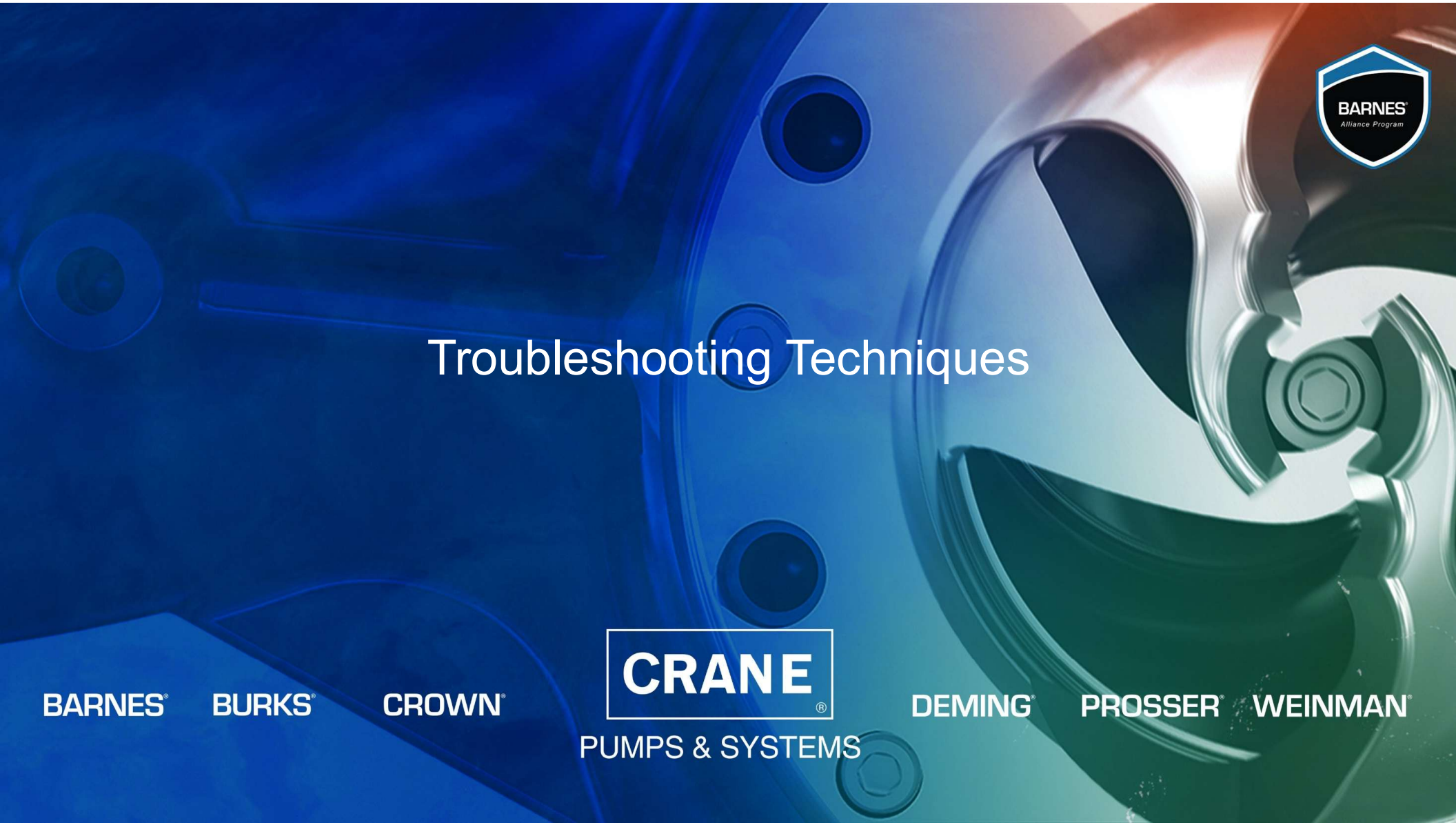
Supply Line Ground Wire

Load Line Ground Wire

Wiring Best Practices: Importance of Grounding

- Helps prevent shock from electrical faults
- Minimizes risk of fires
- Check to ensure you have proper grounding with two simple Steps
  - Confirm continuity from load ground through known
  - Check for voltage between neutral and ground
    - Voltage should be present and under 10 volts for single phase

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Troubleshooting Techniques
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Troubleshooting Techniques 1: At the Panel

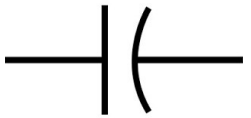
- Most failure modes can be detected right at the panel
- With the panel energized, confirm voltage at the terminal strip
  - If voltage is present, check amp draw from the pump motor leads
  - Does the amp reading exceed the FLA of the pump?
- Attempt to start the pump
  - Use push to run option (if available) or activate level control switch JFP0
  - Listen: Does the contactor in the panel pull in? Does the pump make any noise?

Slide 17

JFP0 Personally I’d do this first vs starting the pump. But don’t know how most service guys do it.
Portillo, Jose, 2025-01-22T14:50:53.396

Troubleshooting Technique 2: Capacitors

- Capacitors are electrical components that store and release electrical current
- Necessary to provide the initial power surge to kickstart the motor
  - Provides the start torque needed to overcome initial resistance
  - Permanent split capacitors typically only have one capacitor
  - Larger HP pumps will often contain two (Start and Run Capacitors)
  - Capacitors can be housed internal to the pump or in the control panel
- If your pump fails to turn on when energized, one of the first places to look is the capacitor



Capacitor Symbol

Troubleshooting Technique 2: Capacitors Continued

- To test if you have a failed capacitor:
  - Step 1: DE-ERNERGIZE the capacitor
    - Can cause shock or burns
    - Use an insulated tool (ex: screwdriver)
    - Touch both terminals simultaneously
  - Step 2: Check the microfarad rating on the capacitor (µF)
  - Step 3: Confirm reading matches the rating
- If capacitor fails, ensure new capacitor matches both µF and voltage rating of failed capacitor

Capacitor Symbol

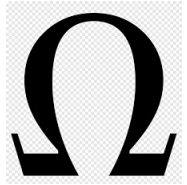
Typical capacitance tolerances is between 5%-10%

Troubleshooting Technique 3: Level Controls

- All power at the panel can be turned off.
  - For a two float configuration
    - Check the highest set float (alarm)
      - Check continuity between the two leads with the float deactivated (there should be no continuity)
      - With the switch activated, check the continuity again to ensure continuity is present
    - Check the second float (On/Off)
      - Check the float both in the on and off positions.
        - Continuity should be present in the on position, not present in the off position

Float in OFF Position (OL)

Float in ON Position (8.8 ohms)*

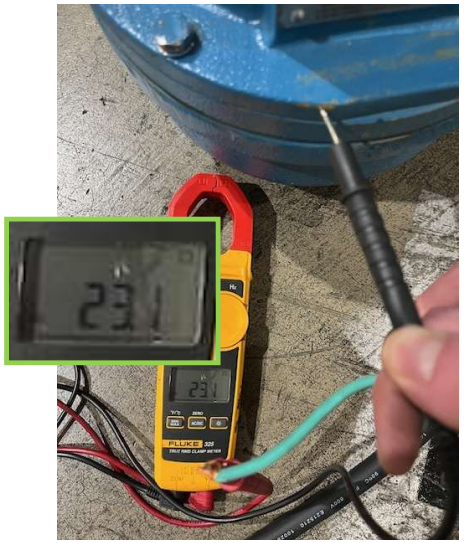


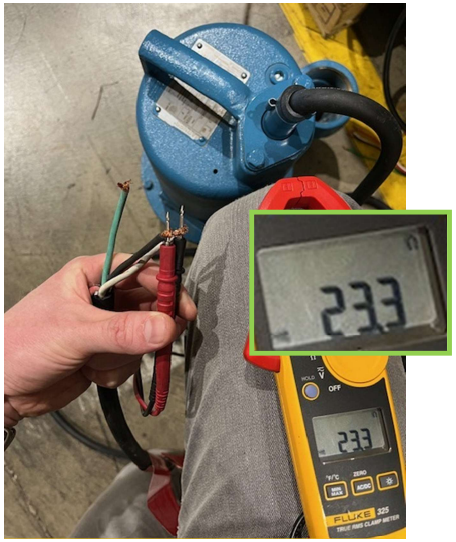
Resistance Symbol

**Resistance reading will vary from float to float*

Trouble Shooting Techniques 4: Pump Continuity Checks

- If the panel and level control passes electrical checks, we then investigate the circuit integrity of the pump.
- Disconnect the pump wires from the panel
  - Check continuity between the two motor leads (typically black and white for single phase)
  - Check if there is a ground short by testing continuity from the green ground wire to each of the two motor leads
    - If there is continuity between the ground wire and either lead wire, the pump needs to be removed from the station





Resistance reading will vary based on pumps HP & Voltage Rating

Troubleshooting Technique 5: Remove Pump

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- At this point, if the we have ensured electrical integrity starting at the panel, through the level control, and to the pump, we can have the pump removed.
- Again, ensure the panel is de-energize and disconnect all power cords
- What to Look For:
  - Does the impeller spin freely?
  - Is corrosion present around the cord entry?
  - Is there corrosion around the cord entry?

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