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BASIC ELECTRICITY

There are two types of current direct D.C. current and alternating current A.C.

Direct current is flowing in one direction only and is essentially free from pulsation. Direct current is seldom used in water and wastewater plants except in motor generator sets, some control components of pump drives and stand-by lighting.

Alternating current is periodic current, which has alternating positive and negative valves. It runs in cycles from 0 to maximum strength, back to 0 and is the same strength in the opposite direction, which comprises a cycle.

A.C. voltage in the United States is 60-cycle frequency, or "HERTZ", which means that this happens 60 times per second.

Alternating current is classified as: Single phase, two phase, three phase, and poly phase. Common types of single and three phase voltage are 110 volt, 120 volt, 208 volt, 220 volt, 240 volt, 277 volt, 440 volt, 480 volt, and 550 volt. Most treatment plants are 110 Volt, 120 volt, and 220 volt single phase with the three phase side being 240, 440, and 480 volt.

All operators should be able to use an ***OHMMETER*** this meter is used to check fuses, wire, and circuits for conductivity, and should only be used when the electrical circuit is off. ***FUSES:*** never remove a fuse or install a fuse without the power being off and using a fuse puller.

Why do we use fuses anyway? A fuse is installed to break the circuit if over-heating or over voltage happens this protects the wiring and equipment. Always use the proper type of fuse. There are several types of fuses.

1. current-limiting protects against current in circuits. 2. Dual-element fuses: motor protection. 3. Time-delay: Electronic and motor starting circuits. 4. Sand-filled: High Voltage. 5. Phase: Protects phase sequence. 6. Voltage-Sensitive: When closed voltage control is needed.

Follow these three steps for proper fuse installation: 1. Inspect bolted connections at the fuse clip or fuse holder for signs of looseness. 2. Check connections for any evidence of corrosion from moisture or atmosphere. 3. Tighten connections.

CHECKING A FUSE 1. Ensure the main disconnect or circuit breaker is in the off position and locked out. 2. Check for live voltage in the panel (power may feed into a control system from other sources). 3. Remove fuse with fuse pulling device. 4. Test resistance of a fuse using an ohmmeter (an open circuit [infinite resistance] indicates a blown fuse, whereas, a short circuit indicates a good fuse). 5. Only in the event it is not possible to disconnect incoming power should the fuse be checked with power applied.

CIRCUIT BREAKERS these are the fuses of today! Circuit breakers are used as disconnecting devices to protect electrical systems primarily from short – circuit conditions, which may occur on the load side of the circuit breaker. May be used to protect motors from overload but normally are used to protect the entire system. TYPES OF ***CIRCUIT BREAKERS:*** Molded-case circuit breakers these type circuit breakers can be thermal-magnetic trip or magnetic only. ***THERMAL-MAGNETIC*** provide both overload protection and short circuit protection. ***MAINTENANCE OF MOLDED-CASE CIRCUIT BREAKERS:*** Manually trip and operate the mechanism, check connections for tightness, inspect for evidence of overheating on the line and load side

conductors, and inspect the circuit breaker case for evidence of overheating.

THERMAL-MAGNETIC CIRCUIT BREAKER: A thermal – magnetic circuit breaker must have a continuous current rating of at least 115% of motor full load amps and the loading must be as great as 250%. Therefore the thermal overload- sensing device will not trip the breaker unless there is 115% overload present.

MOTOR PROTECTION: In most cases, by the time the thermal-magnetic circuit breaker trips the motor will have been seriously damaged. To overcome this problem there is a need for a device called a motor starter.

OVERLOAD HEATERS: Never increase the rating of the overload heaters because of tripping. You should find the problem and repair it.

INTERNAL THERMAL PROTECTION: Three phase motors with internal thermal protection have thermostats bedded in each phase of the three phase windings. These are labeled P1 and P2.The switches are connected into the motor control circuit which will open the magnetic starter contacts when an over-temperature condition occurs in the windings. There are two types available: 1. Automatically restarts. 2. Must be manually reset in order to restart.

GROUND: All equipment must be grounded. Contacting motor frames, tools and electrical equipment to ground is a safety precaution which protects you, and the motors, tools and equipment. ***WHY GROUND?*** If one of the conductors opens up and is not connected to ground, than you become the ground, the current could flow through you and you could receive a severe or fatal electrical shock. If the current flows through motors, tools or equipment, severe damage could occur.

EQUIPMENT GROUNDS: The third prong on cords from electric hand tools is the equipment ground and must never be removed.

ANNUAL MAINTENANCE: In general, annual maintenance should be performed on all these systems as follows:

CONTROL TRANSFORMERS Check primary, secondary, and ground connections. Check for loose winding/coils. Inspect insulation for signs of overheating as a result of overloading. Check mounting for tightness. Check primary/secondary fusing and fuse clips for tightness.

MOTOR CONTROL CENTERS: Check panel lights for operation. Check control knobs/switches for freedom of movement and contact condition. Check horizontal and vertical bus bars and supports for evidence of heating or arcing and tighten. ***BUS BAR*** refers to the cooper or aluminum bars that run horizontally and vertically in the motor control center, they feed the three-phase power to the branch circuits.

CONTROL RELAYS: Check mounting for looseness. Tighten all screw terminal connections. Check for evidence of overheating or arcing indicated by carbon buildup or discoloration of plastic housing. Clean and vacuum enclosure.

THREE (3) BASIC FACTORS contribute to the reliable operation of electrical systems found in Water and Wastewater plants: 1. An adequate preventive maintenance program must be implemented, 2. A knowledge of the system by the operator, even if the operator does not perform the actual maintenance, and 3. Keep it clean, keep it dry, and keep it tight.

CAUSES OF MOTOR MALFUNCTION:

- Overload (Thermal) 30%
- Contaminants 19%
- Single Phasing 14%
- Bearing failures 13%
- Old age 10%
- Miscellaneous 9%
- Rotor failures 5%

IF YOUR NOT SURE OF YOURSELF DON'T DO IT!!! GET A PROFESSIONAL!!!