Technical Information

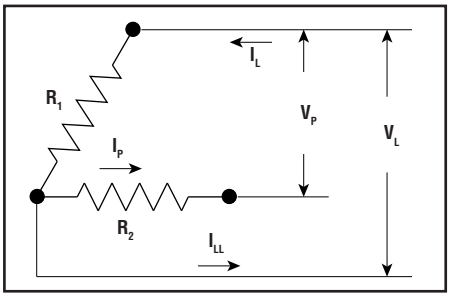
Three Phase Equations & Heater Wiring Diagrams

Open Delta & Wye

Three phase heating circuits are most efficient when operated under balanced conditions. If it is necessary to operate an unbalanced load, the equations below can be used to calculate the circuit values for open three phase Delta or Wye circuits. The terms used in the equations are identified below:

V_L = Line Voltage
V_P = Phase (Element) Voltage
I_L = Line Current (Amps)
I_{LL} = Line Current (Unbalanced Phase)
I_P = Phase Current (Amps)
W_T = Total Watts
R_1 = R_2 = R_3 = Element Resistance
R_C = Circuit Resistance in Ohms Measured from Phase to Phase

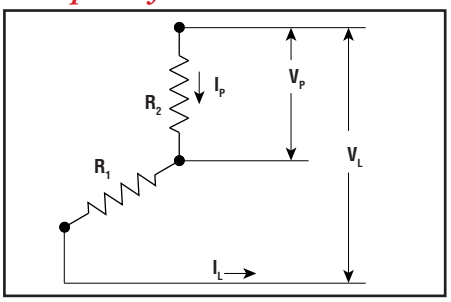
3Ø Open Delta



$V_P = V_L$ | $V_L = V_P$
$W_T = 2V_L \times I_L$ | $W_T = 2 (V_L^2 \div R_1)$
$I_P = I_L$ | $I_L = I_P$
$W_C = 2V_P \times I_P$ | $I_{LL} = 1.73 \times I_P$

The loss of a phase or failure of an element in a three (3) element Delta circuit will reduce the wattage output by 33%.

3Ø Open Wye

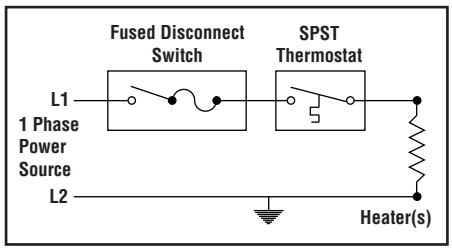


$V_P = V_L \div 2$ | $V_L = V_P \times 2$
$W_T = I_L \times V_L$ | $W_T = V_L^2 \div 2R_1$
$I_P = I_L$ | $I_L = I_P$
$R_C = V_L^2 \div W_C$

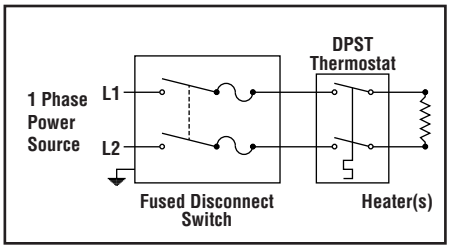
The loss of a phase or failure of an element in a three (3) element Wye circuit will reduce the wattage output by 50%. Heating elements are basically in series on single phase power.

Typical Heater Wiring Diagrams

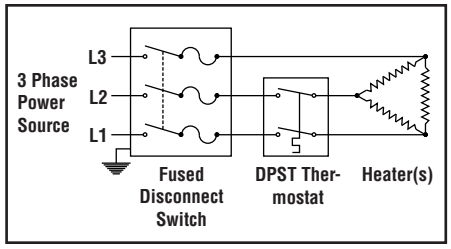
The following diagrams show typical heater wiring schematics.



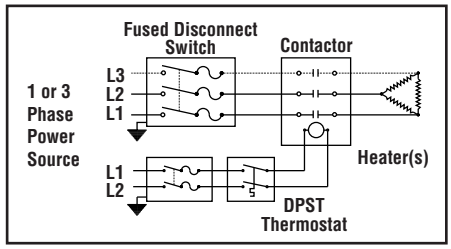
Single Phase 120 VAC heater circuit where line voltage and current do not exceed thermostat rating.



Single Phase AC circuits where line voltage and current do not exceed thermostat rating.

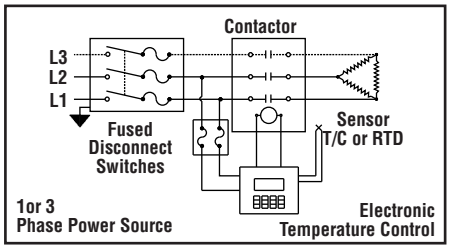


Three Phase AC heater circuit where line voltage and current do not exceed thermostat rating. Circuit does not have a "positive" off.

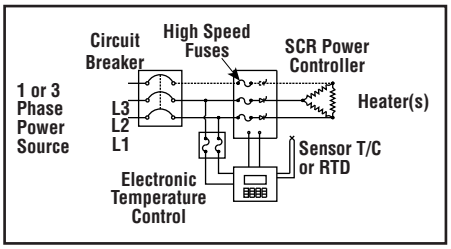


Single or Three Phase AC heater circuit where line voltage and current exceed thermostat rating. Separate control circuit can use a single pole or double pole thermostat. Control circuit requires over-current protection.

WARNING — Hazard of Electric Shock. Any installation involving electric heaters must be effectively grounded in accordance with the National Electrical Code to eliminate shock hazard.



Single or Three Phase AC heater circuit using electronic temperature controllers and contactors. Controller and contactor holding coil must be rated for the same voltage as the heater circuit. Control circuit requires over- current protection.



Single or Three Phase AC heater circuit using an electronic temperature controller and a SCR (solid state) power controller. Controller must be rated the same voltage as the heater circuit. Control circuit requires over-current protection. All electrical wiring to electric heaters must be installed in accordance with the National Electrical Code or local electrical codes by a qualified person.

Wiring & Ambient Temperatures

Ambient temperatures must be considered when selecting wiring materials for electric heater circuits. Heating equipment and processes may cause associated wiring to operate well above ambient temperatures. These temperatures may result from heat conducted from the heater terminals, radiation from heated surfaces or simply high ambient air temperatures. Nickel plated copper or nickel alloy conductors with high temperature insulation should always be used in high temperature areas. Outside these areas, conventional wiring materials can usually be used. 60°C building wire is usually not suitable unless otherwise indicated.

Wiring in Severe Conditions

Moist or wet locations require gasketed terminal and junction boxes to protect equipment and wiring. Rigid conduit is recommended. Hazardous Locations require the use of approved explosion-proof terminal and junction boxes. Rigid conduit or mineral insulated (MI) cable is mandatory in Division 1 areas. Some Hazardous Locations may require conduit seals (EYS) adjacent to the equipment.