

**VAPOR POWER** INTERNATIONAL

**Instruction Manual**

**STR MODEL**

**‘RESISTO-FLO’**

**ELECTRIC BOILER**

## **FOREWORD**

The STR ðResisto-Floö Electric Steam Boiler is designed to provide a compact packaged unit requiring a minimum of electrical and plumbing connections at the jobsite.

When installed according to these instruction, the boiler will provide years of reliable, low maintenance service.

Review both the installation and electrical drawings thoroughly before installing this boiler. A description of this boiler can be found in Bulletin 300, which is included at the end of this text.

## 1.0 INSTALLATION CLEARANCES

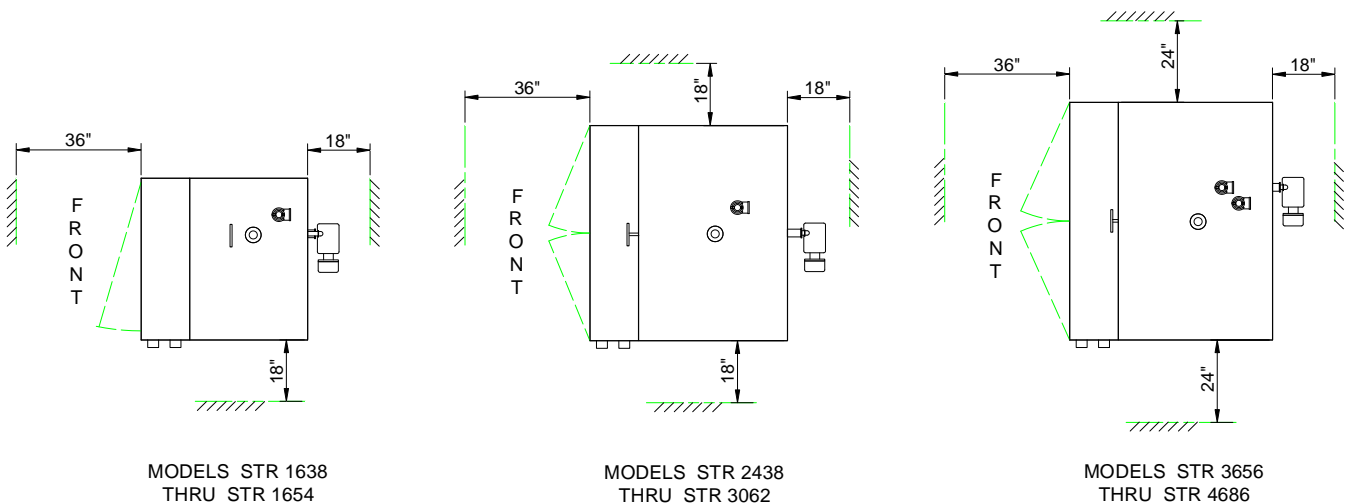
### 1.1 GENERAL

Locate boiler on a level surface. Be sure the location you select permits access to the control cabinet and allows for element removal as dimensioned on the installation drawing, and also that it is in accordance with the minimum spacing specified on the UL label, if provided.

**CAUTION**  
**ALL BOILERS EXCEPT MODELS STR 1638 THRU 1654 ARE TO BE MOUNTED ON NONCOMBUSTIBLE FLOORING.**

### 1.2 MECHANICAL CLEARANCES

The clearances shown below are required for perimeter servicing of the boiler. Note: Front clearance to be 42" if opposing wall is conductive.



### **1.3 THERMAL CLEARANCES**

Minimum thermal clearances should be maintained. If the boiler is UL listed, minimum clearances will be indicated on the UL Label. Otherwise, consult local codes and use good engineering judgement.

**CAUTION**

**THE BOILER ROOM TEMPERATURE SHOULD NOT EXCEED 30° C (86°F),  
WHICH SHOULD LIMIT THE TEMPERATURE WITHIN THE CONTROL  
CABINET TO A MAXIMUM OF 40°C (104°F).**

## **2.0 MECHANICAL INSTALLATION**

### **2.1 STEAM SUPPLY**

Install a steam stop valve on the steam outlet of the boiler and pipe to the equipment to be supplied with steam.

**NOTE: IF THE BOILER IS TO BE CONNECTED TO A COMMON HEADER WITH ONE OR MORE OTHER BOILERS, TWO STOP VALVES ARE REQUIRED BY CODE, ONE OF WHICH SHOULD BE A NON RETURN TYPE, WITH A 1" VENT PLACED IN THE LINE BETWEEN THE TWO VALVES.**

Steam piping from the boiler to the equipment must be pitched to assure proper drainage of condensate formed in the steam line.

**NOTE: IT IS RECOMMENDED THAT ALL PIPING BE CHECKED FOR LEAKS BEFORE INSULATING.**

### **2.2 WATER SUPPLY AND CONDENSATE RETURN**

If a direct water feed is used (ie, no condensate return), the main water supply must have a pressure at least 10 pounds greater than the maximum boiler operating pressure.

If a gravity-feed condensate return is installed, the return must have a head at least 1.1 times the boiler operating pressure ( $\text{psi} = 0.454 \times \text{feet-of-head}$ ).

If a condensate return system is used, the pump should be sized to deliver approximately  $(0.015 \times \text{KW})$  gpm at normal operating pressure and at least the steaming rate at the maximum boiler operating pressure. The receiver tank size (gal) should be at least three times the pump capacity (gpm).

### **2.3 BLOWDOWN**

#### **2.3.1 BOTTOM**

If not factory installed, the slow opening blowdown valve, supplied with the boiler, should be installed on the bottom drain

**NOTE: PER CODE, BOILERS WITH GREATER THAN 100 GALLONS NORMAL WATER CONTENT MUST HAVE 2 BLOWDOWN VALVES IN SERIES. A QUICK OPENING VALVE IS RECOMMENDED FOR THE REDUNANT BLOWDOWN VALVE AND SHOULD BE MOUNTED UPSTREAM OF THE SLOW-OPENING VALVE..**

Blowdown piping must be at least the same size as the blowdown valves and must be directed to an unrestricted discharge drain, separator or tank, depending on the local code requirements. Pitch the pipe toward the drain so that the boiler will drain completely by gravity.

**NOTE: IF THE POINT OF BLOWDOWN DISCHARGE IS ABOVE THE BOILER BLOWDOWN CONNECTION, THEN AN ADDITIONAL VALVE SHOULD BE ADDED TO FACILITATE DRAINING THE BOILER BY GRAVITY (IE, WITHOUT BOILER PRESSURE).**

#### 2.3.1 SURFACE BLOWDOWN

If the boiler is supplied with an automatic surface blow down valve, pipe to a point common with the bottom blowdown piping.

#### 2.3.2 WATER COLUMN BLOWDOWN

If the boiler is not supplied with a water column blowdown valve, install such a valve on the bottom cross of the water column and pipe to a point common with the bottom blowdown piping.

#### 2.4 SAFETY VALVE(S)

The ASME approved safety valves(s), supplied with the boiler, should be factory set at or below the design pressure of the boiler as stated on the boiler nameplate.

**NOTE: THE SYSTEM OPERATING PRESSURE MAY BE LIMITED BY THE SYSTEM COMPONENTS OTHER THAN THE BOILER, IT IS THEREFORE ADVISABLE TO CHECK THE SAFE WORKING PRESSURE OF ALL COMPONENTS IN THE SYSTEM AND IF NECESSARY, REPLACE THE SAFETY VALVE WITH A VALVE SET AT A LOWER PRESSURE, BUT WITH SUFFICIENT CAPACITY ( $3.5 \times KW = \text{LBS/HR REQ'D}$ ) TO ASSURE COMPLETE SYSTEM PROTECTION.**

Safety valve discharge should be piped (using full size pipe with no restrictions) so that steam is directed away from electrical components and to a place where no injuries to personnel can result in the event of a valve discharge. If the valve discharge is piped vertically upward, a seat drain must be provided to eliminate condensate back pressure on the valve seat.

## **2.5 LOW WATER CUTOFF/PUMP CONTROL**

On the ball/float type low water cutoff/ pump control, check that the float blocking plug has been removed and replaced with a solid plug.

## **2.6 PRESSURE LIMIT CUTOUTS**

Check that the high pressure cutoffs are plumb as indicated by the internal leveling pendulum which must swing freely and point to the index mark on the case.

## **2.7 HYDRO TEST**

Good practice, as well as, most local codes, dictates that a hydro-static test, at a pressure equal to the safety valve setting, of the entire boiler system be performed prior to boiler start up. All leaks, both boiler and piping, should be stopped at this time.

**NOTE: SMALL LEAKS (LESS THAN 2 DROPS PER MINUTE) BETWEEN THE BODIES OF THE ELEMNT COMPRESSION FITTING AND THE ELEMENT FLANGES USUALLY STOP DURING THE FIRST FEW DAYS OF BOILER OPERATION. LARGER LEAKS, HOWEVER MAY NECESSITATE TIGHTENING OF THE COMPRESSION FITTING BODY. THIS IS ACCOMPLISHED BY FIRST REMOVING THE ASSOCIATED WIRES/JUMPERS, AND THEN TIGHTENING THE COMPRESSION BODY.**

**CAUTION:**

**DO NOT TORQUE COMPRESSION BODY OVER 70 FT LBS (brass) or 110 FT LBS (SS)**

**NOTE: ALL PIPING, VALVES, AND FITTINGS MUST MEET THE REQUIREMENTS OF LOCAL REGULATING CODES. THE RESPONSIBILITY FOR THE INSTALLATION OF THIS BOILER RESTS WITH EITHER THE OWNER OR THE INSTALLING CONTRACTOR.**

### **3.0 ELECTRICAL INSTALLATION**

#### **3.1 ELECTRIC POWER SUPPLY**

Check the boiler nameplate for the KW rating, voltage, phase and ampacity. Check for the electrical supply to be certain it conforms with the boiler requirements.

Make electrical connections to main terminals housed within the top portion of the boiler control cabinet. Minimum wire size is given both on the electrical schematic and near the boiler terminals. On boilers which require multiple conductors per phase, be certain that phasing is correct and that circuits are not mixed before energizing the boiler.

#### **3.2 GROUNDING**

Connect an equipment ground (minimum copper wire size is indicated on both the wiring schematic and the panel near the grounding lug) to the grounding lug located within the control cabinet.

**NOTE: ELECTRICAL INSTALLATION MUST BE MADE IN STRICT ACCORD WITH (1) THE BOILER'S ELECTRICAL SCHEMATIC, (2) THE NATIONAL ELECTRICAL CODE, AND (3) LOCAL ELECTRICAL CODES.**

#### **3.3 CONTROL CIRCUIT POWER SUPPLY**

On boilers which are not supplied with a control transformer, a fused 120 volt power supply must be connected to the 2-pole terminal block housed within the top of the control cabinet. Refer to the boiler's electrical schematic for required ampacity.



## **4.0 OPERATING INSTRUCTIONS**

**NOTE: PRIOR TO START UP, ANY HEATER OR CONTROL CABINET WHICH HAS BEEN EXPOSED TO DUSTY, WET, AND/OR HUMID CONDITIONS MUST BE THOROUGHLY CLEANED AND DRIED OUT. THE BUILD UP OF DUST AND RUST MAY RESULT IN EXCESSIVE DAMAGE UNLESS THE FOLLOWING PRECAUTIONS ARE UNDERTAKEN:**

- A. All electrical components should thoroughly cleaned and dried, and checked for loose connections.
- B. All electrical terminals should be thoroughly cleaned and dried, then hi-potted or meggered to assure there are no shorts to ground.
- C. Boiler should be inspected for stray objects, metal scraps, etc., which may have accumulated during installation. All such materials must be removed from the boiler prior to start up.
- D. All power wiring connections should be checked to assure tight connections.

**NOTE: HYDRO STEAM INDUSTRIES, AS MANUFACTURER OF THIS BOILER, WILL NOT BE RESPONSIBLE FOR DAMAGES INCURRED AT THE TIME BOILERS ARE STARTED UP UNLESS THE ABOVE STEPS HAVE BEEN TAKEN TO ASSURE THE BOILERS ARE PROPERLY PREPARED FOR STARTUP.**

**NOTE: MAXIMUM OPERATING CONDITIONS AS STATED ON THE BOILER NAMEPLATE ARE NOT TO BE EXCEEDED**

### **4.1 GENERAL**

The following section of this manual should be read in its entirety prior to operating the boiler.

### **4.2 PRELIMINARY CHECKS AND ADJUSTMENTS**

#### **4.2.1 Pressure Control (Boilers supplied with proportioning step controls)**

- A. Pressure Setting ó Most Model STR Boilers are provided with a proportioning type pressure control system which regulates the boiler output to match the system demand. This control should be set at the required operating pressure but shall not exceed 90% of the safety valve

set pressure. Proper system operation can be checked via the pressure gauge mounted on the boiler's sensing manifold.

B. Response/Range Adjustment - For boilers supplied with solid state step controls. A "span" adjustment on the control adjusts the response/differential of the control.

C. Interstage Time Delay - Most solid state step controls now include adjustable interstage time delays. Some even include different delays for steps-on and steps-off which can be adjusted to minimize contactor cycles while still maintaining the required responsiveness of the control. Check the vendor-supplied literature provided at the rear of this manual.

#### 4.2.2 Pressure Control (Boilers supplied with one or more non-proportioning pressure controls)

Smaller STR boilers are provided with one or more independent pressure controls which switch on or off heating elements in accordance with their temperature setting. The differential between the pressure settings should be set in accordance with system requirements.

#### 4.2.3 Pressure Limit Cutouts

Check that the Honeywell "Limitrol" pressure limit switches are plumb using external leveling indicator, which must swing freely and point to the index mark on the case, and is set approximately 10% greater than the pressure control but not to exceed 94% of the safety valve set pressure.

#### 4.2.4 Auxiliary Controls

Other controls supplied with the boiler (eg, KW limit controls, cycle or delay timers, etc) should be set per the Engineer's specifications.

### 4.3 BOILER START-UP

- A. Close blow down, drain and steam stop valves.
- B. Open the feedwater and sight gauge valves
- C. Manually fill the boiler with water to approximately the middle of the sight gauge

**WARNING**  
**ENERGIZING THE HEATING ELEMENTS BEFORE FILLING THE BOILER TO ITS PROPER WATER LEVEL WILL DAMAGE THE HEATING ELEMENTS, THUS VOIDING THE WARRANTY. EVEN THOUGH A LOW WATER CUTOFF IS PROVIDED WITH THE BOILER, THE BOILER SHOULD NEVER BE SWITCHED ON WITHOUT FIRST ASSURING THAT THE WATER LEVEL IS NORMAL**

#### 4.3.1 Control Circuit Checkout

If a separate branch circuit is provided for the 120V control, close the customer's 120V branch circuit power switch; if a control circuit transformer is provided, remove both the primary and secondary fuses and jump a 120V power supply to the secondary of the control transformer.

- A. Switch the control circuit power on, the switch should light to indicate that the control circuit power is energized.
- B. Circuits of heating elements will now be switched on by the step controller or pressure controllers, and pilot lights will light indicating that this function is taking place and, thus, that the controls are operating correctly.

**NOTE: IF A CONTACTOR "CHATTERS", BLOW IT OUT WITH AIR AND THEN CYCLE IT SEVERAL TIMES BY USING THE APPROPRIATE MANUAL ENABLE TOGGLE SWITCH.**

For boilers supplied with step controls, check the recycle feature by briefly interrupting the control power ó the step control should recycle and start in a no- load condition. Perform maintenance checks of the control circuit per paragraph 5.2

Upon completion of the control circuit checkout, de-energize the control circuit, remove the jumpers and replace fuses, if applicable, and switch all of the circuit enable switches to the off position.

#### 4.3.2 Cleaning Boiler Interior

Prior to start-up, the boiler interior should be cleaned to remove oil, mill scale and other construction and installation contaminants. A commercial boiler ÷Boil Out÷ compound should be used, per their procedure, with the boiler completely flooded. In lieu of a commercial boil out compound, the following mix of chemicals can be used for every 250 gallons of water:

- 30 lbs tri-sodium phosphate ( $\text{Na}_3 \text{PO}_4$ )
- 5 lbs caustic soda (NaOH)
- 2 lbs ordinary detergent

These chemicals should be dissolved in warm water prior to their addition to the boiler. The boil-out can be accomplished per the following procedure:

- 1) Remove all tools, rags, etc. from the boiler.
- 2) Remove steam outlet piping.
- 3) Fill boiler to just below the handhole/manhole with feedwater.
- 4) Add the chemical solution thru the handhole/manhole.
- 5) Close handhole/manhole.
- 6) Fill boiler until water level is just below the steam outlet
- 7) Energize the main power supply by closing the customer's branch circuit power switch.
- 8) Make sure that all step toggle switches are in the off position, and then energize the control circuit
- 9) Operate 1 or 2 heater circuits (approx 10% of boiler capacity) to raise water temperature.
- 10) Once steam is observed at the steam outlet, allow boiler to boil for 2-3 hours. Note: Heater circuits may have to be de-energized during this period to control the boil rate..
- 11) Switch control circuit off and de-energize main power supply
- 12) Drain boiler.
- 13) Open handhole/manhole
- 14) Rinse all walls and surfaces thoroughly with a garden hose
- 15) Re-install steam outlet piping

#### 4.3.3 Boiler Start-Up

Fill boiler to normal water level and energize the main power supply by closing the customer's branch circuit power switch.

Repeat steps 4.3.1 A and B to start the boiler.

Using the enable switches, gradually switch on the circuits.

Once pressure is achieved in the boiler, gradually open the steam outlet valve to establish a load on the boiler.

Individually check each element circuit to assure that each leg is drawing its rated current.

**NOTE: SOME POWER FUSES MAY BLOW AT STARTING DUE TO WATER OR OTHER CONTAMINATION ON THE ELEMENT TERMINALS, SINCE THIS CONTAMINATION USUALLY "BURNS" FREE, MERELY CHECK THE CIRCUIT FOR A SHORT AND THEN REPLACE THE FUSE. IF A SHORT EXISTS, HOWEVER, REPLACE THE DEFECTIVE ELEMENT PER PARAGRAPH 5.3.3**

#### 4.4 BOILER SHUTDOWN

Switch the control circuit power off. For boilers supplied with step controls, this will automatically recycle the step controller to no load so that when the boiler is again switched on, no contactors will be initially energized.

## **5.0 MAINTENANCE**

### **5.1 BOILER**

#### **5.1.1 Blowdown**

Boiler should be blown down periodically to remove any accumulated sludge.

This should be done at least once a day unless experience indicated differently.

Sight gauge and water column should both be blown down daily to remove any sludge that could have formed.

#### **5.1.2 Pressure Vessel**

Assure annual inspection by qualified ASME Boiler and Pressure Vessel Inspector. This inspection will cover the vessel and relief valve only.

#### **5.1.3 Heating Elements**

Make periodic checks for loose terminal and wiring connections. If all elements have been operating normally and all circuits draw rated current, no element tests are required. If element failure is suspected, the elements should be checked individually with an ohmmeter. Grounded elements may require a ðMeggerö for detection of failure.

## **5.2 CONTROL CIRCUITS**

#### **5.2.1 Pressure Limit Cutouts**

Check cutout action of pressure limit controls by adjusting below existing steam pressure. The step control should reset to no load.

#### **5.2.2 Low Water Cutoff/Water Feeder**

Check the low water cutoff action by periodically blowing down the water column as quickly as possible. The step control should always reset to no load.

#### **5.2.3 Pressure Control**

A check of the proportioning pressure control system can be made by moving the set point of that controller up or down scale and noting the corresponding action of the step control. If the step control fails to follow in either direction refer to the appropriate descriptive literature at the rear of this manual.

### 5.3 MAJOR COMPONENTS

#### 5.3.1 Contactors

Periodic inspection and cleaning of contactors should be made. Check for pitted, burned or welded contacts and inoperative coils. Discoloration of the terminals, contacts and/or Bakelite is usually indicative of a loose connection or failed/failing contactor.

#### 5.3.2 Fuses

Check for loose fuse clips and wires. Inspect for discoloration of clips due to overheating, which usually indicates a loose connection or bad clip contact..

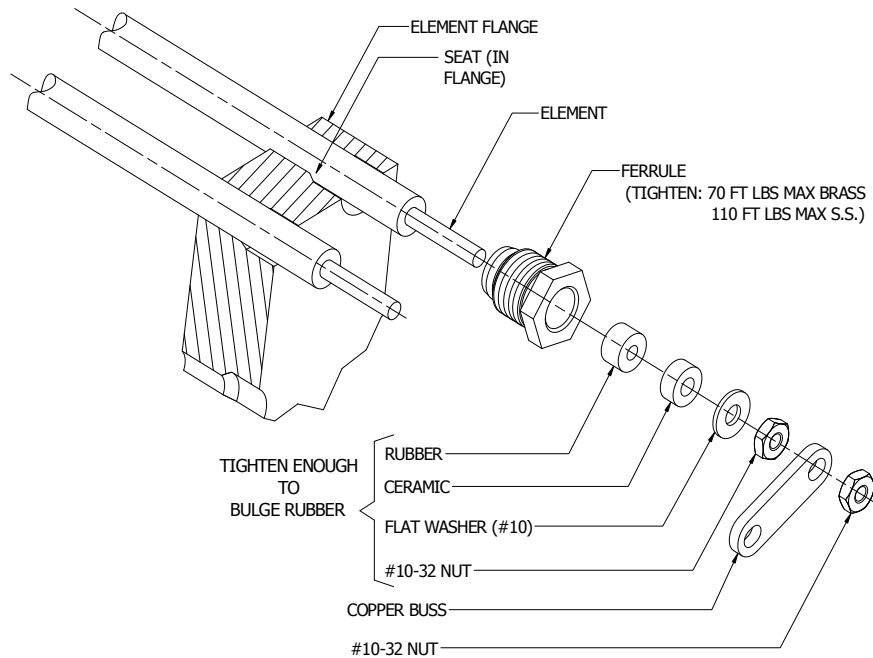
#### 5.3.3 Elements

The resistance type immersion elements are field replaceable with standard tools. To replace defective elements, use the following procedure:

1. Turn off power to the boiler
2. Drain boiler below level of flange containing defective element.
3. Number and tag element wires and terminals to assure proper reassembly
4. Disconnect element wires to the flange
5. Remove flange from boiler nozzle
6. Remove buss bars, nuts, insulators and washers from the defective element
7. Remove compression nut which holds the element in the flange
8. Slide element through flange (toward terminal side) far enough to cut element off behind compression ferrule
9. Pull defective element back through flange
10. Clean the ferrule seat in the flange
11. Make certain replacement element is correct size. Check both the voltage and KW rating stamped on the element itself
12. Slide new element through flange (from element bundle side), making sure orientation is correct.
13. Install new compression fitting (ferrule) on element. Shorter end of element should extend at least 1/8" beyond compression nut after tightening (refer to element assembly sketch)

**NOTE: TIGHTEN COMPRESSION FITTING TO 70 FT LBS Brass, 110 FT LBS SS MAX.**

14. Reverse the procedure outlined in steps 4-6 above using a new flange gasket.
15. Refill boiler and purge air from system.
16. Check for leaks both before and after system is pressurized.



**DETAIL - ELEMENT INSTALLATION**

**5.3.4 Probes**

Level probes should be periodically checked. If there is any seepage between the conductor and its insulator or between the insulator and the compression fitting, replace the probe.

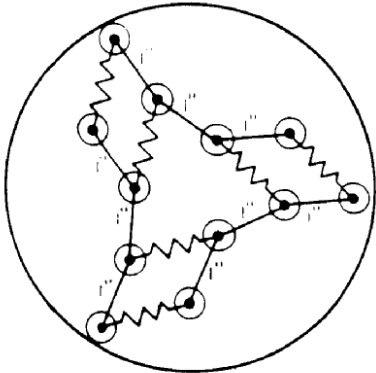
**5.4 CLEANING THE BOILER**

Boiler should be drained and cleaned periodically to remove any accumulated scale or sludge. This can normally be done at the time of annual inspection unless experience indicated that more frequent cleaning is required. Check for pitting of vessel wall near water level and bottom head. Removal of the lowest element flange usually facilitates this inspection.

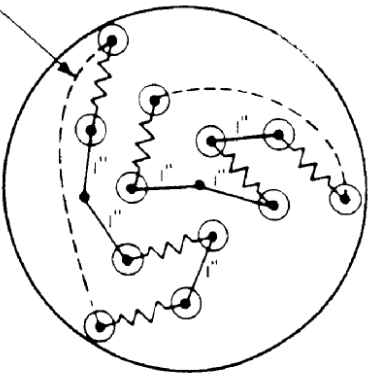


# FLANGE WIRING DIAGRAM

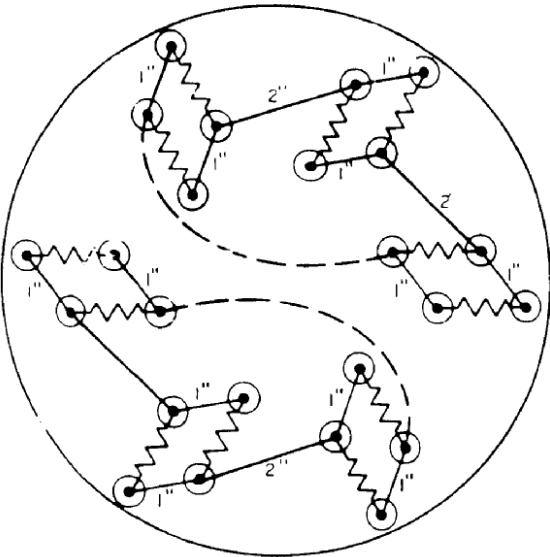
WIRE JUMPER (TYP)



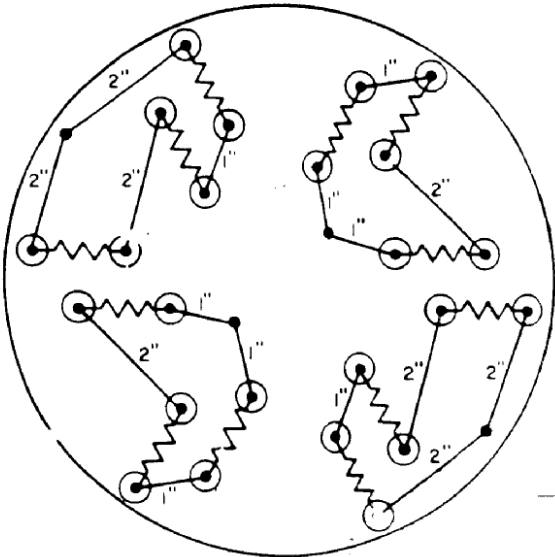
5" SINGLE DELTA



5" DOUBLE DELTA

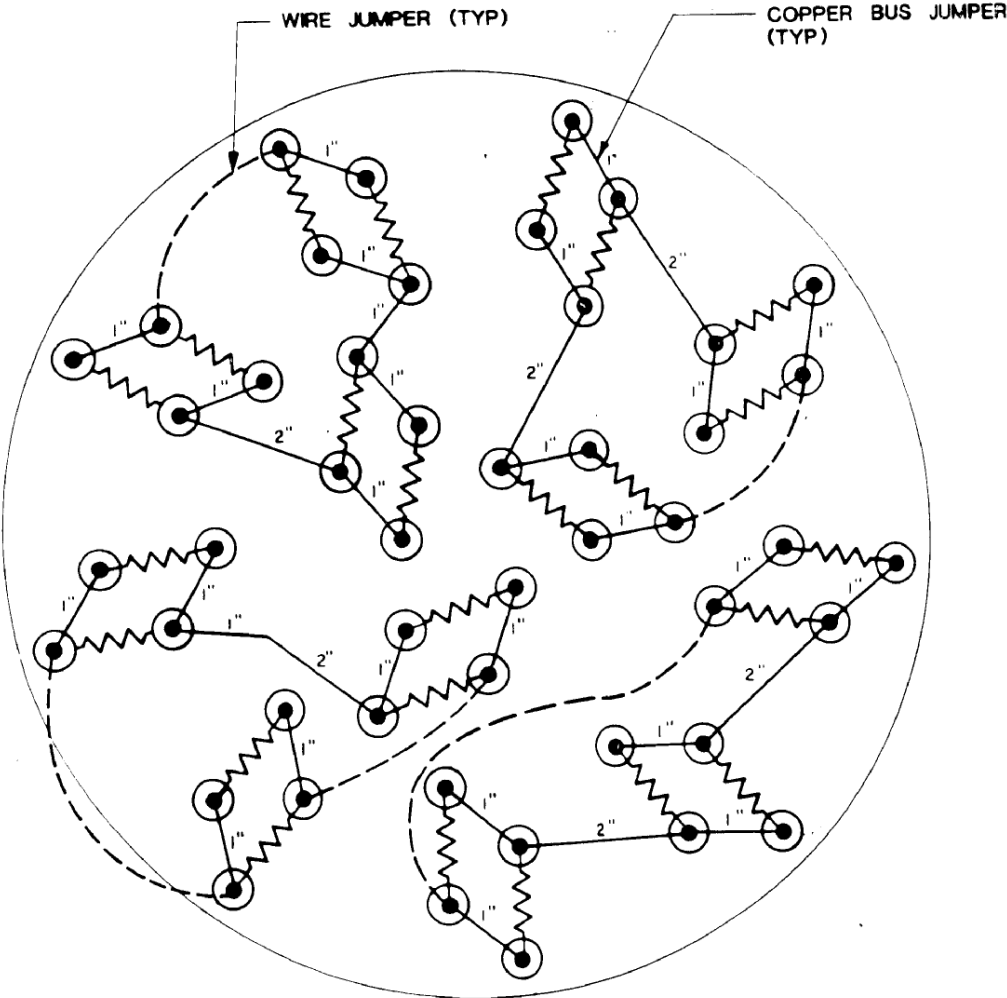


8" DOUBLE DELTA



8" QUAD DELTA

# FLANGE WIRING DIAGRAM



10" QUAD DELTA