Bulletin 1006
Revised

MOBILE QUENCH SYSTEMS

MODELS QT350A and QT200A
AND
MODEL JQF JOMINY QUENCH FIXTURE

Service Manual

and

Parts List

McENGLEVAN

Makers of SPEEDY-MELT Furnaces

700-708 Griggs Street • P.O. Box 31 • Danville, Illinois 61832

Revised 2018

12/2012 Watlow EZ-ZONE Temperature Controllers

The QT350A quench tank is equipped with two Watlow EZ-ZONE temperature controllers. The top instrument is the control instrument and the lower is the high limit. These are pre-tuned at the factory for optimum performance and are tested at two temperature setpoints. When you receive your unit, all you need to do is apply power, turn the toggle switch to the on position, and the unit will begin heating to one of the last setpoints from the factory. The instrument has an upper and a lower display. The upper display is the process temperature or tank temperature, and the lower display is the current setpoint. All that is needed to change the setpoint is to depress the upper or lower arrows on the right hand side of the instrument and the setpoint in the lower display will begin to change up or down. The speed of change will increase the longer the button is depressed.

There is no need for further tuning of the instrument, but if you wish to, please consult the supplied operating manual (on CD) from Watlow before attempting to do so.

INTRODUCTION TO HEAT TREATING

A simple definition for the heat treating process for steel is the procedure used to alter or refine the grain structure through thermal treatment. There are three distinct steps in hardening and tempering steel and its alloys.

THE FIRST STEP, usually referred to as "hardening", is to heat the steel slowly and uniformly to a temperature high enough to initiate changes in the grain structure. This temperature is within, or above, the red heat range and is usually referred to as the critical, or quenching temperature. These temperature ranges are determined by the alloy additions or chemical composition, and may vary from 1400°F. for plain carbon steels to 2375°F. for high speed alloy steels. All companies and mills which manufacture tool steels will furnish the correct hardening temperatures and a range of tempering temperatures for specific steel hardnesses. They will also specify which quench media to use - whether air, oil or water.

THE SECOND STEP is quenching the steel, wherein the steel is cooled to a temperature below the red heat range, to a predetermined temperature, within a specific period of time. The heat can be extracted by a variety of liquid coolants, gases or air. Each type media removes and dissipates the heat at different speeds or rates. Here again, the steel analysis is a determining factor in the selection of the quench media.

The purpose of quenching is to fix, or set, some of the structural changes caused by heating the steel through its critical temperature range. The correct quenching procedure refines the grain structure, and increases the hardness and tensile strength of the steel, but it also reduces the toughness and ductility. Steel in a full hardened condition is highly stressed and too hard and brittle for practical use, so it is necessary to reduce the hardness and increase the toughness and ductility.

THIS THIRD STEP is called tempering, or drawing the hardness down. The tempering temperature is always below the red heat, or critical temperature, seldom exceeding 1100°F. For example, punches and dies must be strong and wear resistant, so they are tempered, or drawn back, to a relatively high hardness. For oil hardening steels, the tempering temperature would be in the range of 375°F. to 425°F. for a Rockwell "C" hardness of 60-62. Springs made of oil hardening steels must be tougher and more resilient, so the tempering range of 675°F. to 725°F. is frequently used, for a hardness range of 44 to 48 Rockwell "C" hardness. Automobile axels and drive shaft members require greater toughness and ductility, so they are drawn back at a temperature range of 1025°F. to 1075°F. to a hardness range of 34 to 38 Rockwell "C".

All three steps in heat treating are critical, and of equal importance. Non-uniform heating to the critical temperature can cause warping and initiate intergranular cracks because of non-uniform expansion of the punch or die section. Once this happens, the tool steel structure is ruined during the first step of the heat treating procedure. Subsequent quenching merely aggrivates and finalizes the failure by cracking or warping.

The advantages of correct heating through the critical temperature can be lost through improper quenching methods and techniques. Thousands of die sections are lost because they are heated, then dropped into a bucket, or similar container of quench media, with no consideration given to correct and uniform cooling or agitation.

Finally, correct heating and quenching procedures can be lost by tempering the tool in a furnace or oven which does not hold an even, uniform temperature throughout the work chamber.

THEORY OF QUENCHING

There are three distinct stages in the quenching operation, where a liquid media such as brine, water or oil are involved. These are referred to as the A, B, and C stages.

THE INITIAL OR VAPOR BLANKET STAGE IS KNOWN AS A STAGE. When the heated steel object is plunged into the quench media, it is immediately enveloped in a blanket of oil vapor when oil quenching, or by steam, when water quenching. The insulating blanket is created by the extreme heat emitted by the steel. The vapor blanket retards heat transfer from the hot metal to the main body of the quench media. Heat from the steel is transferred through the vapor barrier to the main volume of the quench media only by radiation. If the vapor barrier persists for a prolonged period of time, the initial cooling stage may be extended for a long enough period to produce incomplete hardening of the steel. Pockets, or cavities in dies may trap and hold the vapor blanket. This causes incomplete hardening in those areas because the steel must be cooled within a specific period of time to cause the hardening structure to "set" or form. As steel cools, the vapor barrier collapses and the quenching process enters the second vapor transport or the critical cooling stage. *THE DURATION OF THE VAPOR BLANKET STAGE, OR REMOVAL OF THE VAPOR BLANKET FROM DIE CAVITIES, CAN BE REDUCED DRASTICALLY BY AGITATING THE QUENCH MEDIA.* The liquid is flushed or pumped

across the hot steel surface with sufficient velocity to dissipate and flush away the vapor barrier. Thus, the steel cools more uniformly and enters the second, or Critical Cooling Stage more rapidly.

When the vapor blanket is eliminated, or flushed away, the quench media "wets" the surface of the steel and initiates the second *CRITICAL COOLING STAGE B*. Heat transfer is greatly increased in this stage through a boiling action of the quench media. The quench media in contact with the hot metal vaporizes and the vapor bubbles dissipate into the main body of the quench media, transferring heat very rapidly to the main volume of quench media. The vaporized media is rapidly replaced by cooler quench media, which vaporizes immediately to repeat the procedure. During this stage, the temperature of the steel drops rapidly. The cooling action and heat dissipation can be increased and made more uniform through agitation, or increasing the flow of quench media over the surfaces of the steel.

The Final, *OR C STAGE, IS THE SLOW COLLING STAGE*. At this point the steel is below the boiling point of the quench media and cooling takes place through heat conduction to the quench media.

Efficient quenching requires that *VAPOR BLANKET A AND CRITICAL COOLING STAGE B* take place as rapidly as possible. This is particularly important at Stage B when rapid temperature drop is essential to assure complete transformation to the hardened structure. When the Final, or C Stage is reached, the slower rate of cooling is preferred to avoid stresses and strains with result in distortion and quench cracks.

MOBILE QUENCH SYSTEMS MODELS QT-350A AND QT-200A

Several manufacturers make quenching systems for industrial application. McEnglevan is the first to introduce small, compact, portable systems.

The Mobile Quench Systems QT-350A and QT-200A are designed and engineered for tool room hardening and metallurgical training laboratories. They help to develop the maximum physical properties the metals can reach, by correct quench practice. These factors are extremely important in tool and die hardening, and in Metallurgical Technology.

Three important factors are stressed in design of the systems: ample volume of quench media, agitation or circulation, and temperature control of the oil quench system.

The basic formula for the volume of oil or water in quench systems is one gallon of quench media, per pound of steel quenched per hour at 1500°F. Total quench media capacity of both 350A and 200A Quench units is sixty gallons. The pump chamber contains 15 gallons and the capacity of the quench chamber is 45 gallons. A piece of steel one inch square by one foot long weighs about 3½ pounds, so fifteen such pieces per hour would be the maximum capacity of a sixty gallon system. *THIS VOLUME OF QUENCH MEDIA EMPHASIZES THE FALLACY OF THE AVERAGE SHOP PRACTICE OF USING A FIVE GALLON CONTAINER FOR QUENCHING.* All the care, time and good furnace practice used to heat the steel properly can be completely lost by improper quenching.

Agitating or flushing the quench media over the hot steel is one of the simplest and most effective means of removing the vapor or steam envelope. This is the method used in the Mobile Quench Systems. A powerful impeller type agitator pumps the quench media into the bottom of the quench chamber then re-circulates it back into the pumping chamber. A catch basket, suspended in the quench chamber simplifies retreiving dropped tools or parts.

THE QT-350A QUENCH SYSTEM IS USED WITH OIL

In most to tool and die shops, oil hardening steels are most commonly used, so the Model QT-350A system will be most prevalent. Quench media temperature is important due to several factors.

Several types of quench oils are used for heat treating steel. They can be straight pale paraffin oils with high flash fire points, or the new additive type quench oils. They are formulated to give fast wetting action with low vaporization when in contact with hot steel. Quench oils are manufactured by all leading petroleum companies such as Sinclair, Shell, Standard Oil, and Gulf Oil Companies. Information is available from your local bulk plants or offices. One firm specializing in Quench oils is E. F. Houghton Company, PO Box 930, Valley Forge, Pennsylvania 19482.

The straight pale oils are most efficient when held at 130 F. to 150 F. The higher temperature lowers the viscosity of the oil, gives better agitation and heat dissipation and a short vapor barrier stage. *CAUTION: USE CARE WHEN FILLING THE QT 350 OIL QUENCH UNIT WITH QUENCHING MEDIA. OIL EXPANDS WHEN IT IS HEATED, SO THE OIL LEVEL SHOULD BE JUST BELOW THE OIL OVERFLOW BAFFLE WHEN THE OIL IS COLD, OR ON THE INITIAL FILL. FINISH FILLING THE SYSTEM, AFTER THE QUENCH MEDIA HAS ATTAINED OPERATING TEMPERATURE, TO A LEVEL OF ABOUT ONE-HALF INCH ABOVE THE OVERFLOW BAFFLE.*

The new additive type oils are formulated to operate up to temperatures as high as 250°F. to 300°F. There are certain advantages to quenching into oils at these temperatures, but quench systems of this type should have a minimum capacity of 400 gallons. Information on these oils are available from your supplier. *SPECIAL HIGH TEMPERATURE QUENCH UNITS ARE DESIGNED FOR THE SPECIAL OILS.*

The QT-350A Quench System is equipped with electric immersion heaters, to heat the oil to the required temperature. A temperature controlling instrument controls the temperature automatically, and is designed *WITH AN ADDITIONAL SET OF HIGH LIMIT CONTACTS TO SHUT OFF THE ELECTRIC POWER TO THE TANK IN CASE OF CONTROL FAILURE.* The immersion heater is located in the pump chamber, so the overall quench media temperature will not exceed set temperature. The quench capacity of 50 to 60 lbs. of parts, or dies, per hour should be ample for the average tool shop or school laboratory.

THE QT-200A QUENCH SYSTEM

Water is most effective when maintained between temperatures of 60°F. and 70°F. Heat is conducted and dissipated rapidly at these temperatures. As the temperature of the water increases, its quenching efficiency decreases, since the water is closer to its vaporization or boiling point. The vapor barrier around the hot steel forms more rapidly and is sustained for a longer period of time. The flushing action of the pump in the QT-200A will help to alleviate this problem, as will the greater volume of water in the quench system. The easiest and least expensive way to control water temperature is by adding tap water. The QT-200A has a water tap connection and overflow for this purpose. A temperature control instrument operates a solenoid operated electric valve to add cold water to the quench system to lower the water temperature.

AQUEOUS SYNTHETIC QUENCHANTS, SUCH AS SOLUTIONS OF POLY-VINYL ALCOHOL AND OXALKYLENE-POLYGLYCOL, ARE EXCELLENT REPLACEMENTS FOR QUENCHING OILS. In addition to noncombustibility, they possess other advantages.

For instance, concentrations can be varied to produce a wide range of quenching speeds, resulting in properties equivalent to, higher, or lower than those attainable with oil. For any given concentration, furthermore, quenching speeds can be controlled by varying quenchant temperature and degree of agitation. As an example, a 25% concentration in water will develop quenching speeds comparable to those of oils. Decreasing the percentage increases quenching speeds, as does lowering the bath temperature.

As for ecological compatibility, synthetic quenchants are much less hazardous than quenching oils. Their biodegradability and threshold limiting values, however, expand upon the specific polymer and sythetic quenchant.

The one disadvantage of using the aqueous synthetic quenchant is the need for close control of the concentration of the additive. Continuous monitoring is required to maintain a constant cooling rate and consistent results.

We do not recommend the use of the QT-200 or 200A for brine quenching. The corrosive action of the brine solution will cause rapid deterioration of the tank and circulating system. Custom units constructed with stainless steel tank and components are available at higher costs.

HOW TO USE QUENCHANTS WITHIN OSHA REGULATIONS

Oils are hazardous if they're not handled properly. Safety precautions, alternative quenchants, and OSHA rules are all very important considerations. Both viscosity and flash point of a quenching oil are important.

Steels are hardened by austenitizing and quenching into oils, molten salts, water or aqueous solutions. Of these liquids, quenching oils present some hazard with respect to flammability or combustibility, and molten salts need care in handling. All currently used quenching oils are in Class III B, and do not have to be labeled "flammable." Typical quenching oils have a minimum flash point of 260°F., and 350°F. on the average.

When using combustible quenchants (mineral oils), certain precautions must be kept in mind. First, both viscosity and flash point of a quenching oil are important.

Generally, any given oil will have a lower viscosity at higher temperatures, and vice versa. *WHEN A HOT PART IS IMMERSED INTO A LOW VISCOSITY OIL, THE FIRE HAZARD IS LESS* even if the oil's flash point is comparatively lower. This effect occurs because heat extracted from the part is distributed rapidly through the oil by the "thermo-syphon" effect. Thus, oil contacting the hot metal at the air interface does not reach and exceed its flash point.

Quenching oils with comparatively high viscosities do not distribute heat as rapidly. Instead, a comparatively thin layer of oil is heated at the part surface, and gets hotter as it flows upward. Thus, the oil can reach the air-oil interface at a temperature which is higher than its flash point. The oil may even pass its fire point, catching fire immediately.

Thus, two precepts are apparent. First, *IT IS WISE TO PREHEAT COLD, VISCOUS OILS TO DECREASE THEIR VISCOSITIES,* thereby decreasing liklihood of ignition. Second, *THOUGH HIGHER-FLASH-POINT OILS SHOULD BE SOUGHT, OILS WITH LOWER VISCOSITIES ARE PREFERRED.*

EQUIPMENT FAILURES

When being quenched into oil baths, *THE HEATED PART SHOULD BE IMMERSED RAPIDLY AND COMPLETELY.* Partially immersed parts always cause fires. Emergency measures to assure complete immersion must be available should equipment fail.

PART DESIGN

Design of parts to be quenched is important. For example, if a part has a hot open tube, vertical quenching would result in a fountain of hot, burning oil spurting from the hole. Safety rules require vertical tubes to be immersed rapidly, and horizontal tubes should have a stream of oil pumped through the inside. When quenched, a large, heavy part which has numerous hidden pockets could squirt oil violently in several directions.

WATER SHOULD BE KEPT AWAY FROM OIL BATHS. If there is only a small amount of water (less than o.1%) the bath can foam excessively, increasing fire hazards. There is also a possibility of non-uniform mechanical properties, cracks, and distortion of quenching parts.

REDUCING THE HAZARDS

The next logical step toward increasing safety would be replacement of oils by non-combustible quenchants with comparable quenching speeds. This rules out water and aqueous salt solutions, which have much higher quenching rates than oils. The solution of poly-vinyl or polymer are excellent replacements for quench oils, however, very close control of the concentration of the additive is necessary.

OSHA RULES

Several OSHA regulations directly affect heat treaters, as follows:

TANKS EXCEEDING 150 GAL. CAPACITY

1. Tanks of over 500 gal. capacity have to be equipped with bottom drains so that they can be drained from a safe position (in event of fire) to a salvage tank of equal or greater capacity. This salvage tank must be at a safe outside location so that life or property will not be endangered.

2. Drain pipes require the following minimum internal diameters: 3 in. for 500 to 750 gal. tanks, 4 in. for 750 to 1,000 gal. tanks, 6 in. for 2,500 to 4,000 gal. tanks, and 8 in. for tanks of more than 4,000 gal.

3. All tanks which are over 150 gal. capacity or over 4 sq. ft. in surface area shall have at least one fire extinguisher.

*4. Manual fire extinguishers are required in the vicinity of quenching tanks containing combustible fluids (oils), conforming to National Fire Prevention Ass'n. (NFPA) code 10 for fires of liquids.

5. Automatic water-spray equipment must conform to NFPA Code 15 to protect tanks, drainboards, and stock.

6. Automatic fire extinguishers using foam must conform to NFPA Code 11, type to be compatable with fluid in the tank.

7. Automatic fire extinguishers using carbon dioxide must conform to NFPA Code 12, and fire extinguishers using dry chemicals must conform to NFPA Code 17, to protect tanks and drainboards. (As a note, only the water spray and carbon dioxide types are suitable for extinguishing oil fires. Water-sprayed oil can be dried and reused, while oils extinguished by carbon dioxide do not need further treatment. Foam and chemical solutions affect oils adversely so that baths require replacement of the oil.

*8. *TANKS REQUIRE SAFETY COVERS, WHICH MUST BE PLACED ON THE TANK IMMEDIATELY IF IT CATCHES FIRE. THESE COVERS NORMALLY SHOULD BE CLOSED WHEN THE TANK IS NOT IN USE.*

*9. *ALL TANKS,* chains, hoods, and other components *MUST BE MADE OF APPROPRIATE FIRE-RESISTANT MATERIAL OF ADEQUATE STRENGTH.* Furnace supports must possess not less than 1 hr. resistance to fire.

10. Tanks of over 150 gal. capacity or over 4 sq. ft. surface area require a properly trapped overflow pipe at least 3 in. in diameter. The bottom of the drain pipe must not be less than 6 in. below the tank top, and the pipe must be able to drain the maximum rate of water flow from overhead sprinklers.

*11. Quenching tanks must be located as far as practicable from furnaces.

*12. *QUENCHANT PREHEATERS MUST BE CONTROLLED TO PREVENT OVER-HEATING WITHIN 50°F. BELOW THE OIL'S FLASH POINT.*

*13. Compressed air must not be used to agitate or circulate quenching oil.

*14. All electrical equipment (wiring and the like) must be safe and positioned away from combustible vapors or hot furnaces.

15. Ventilating equipment must be instrumented so that failure in any area automatically stops operations in that area.

* Applies only to QT 350A - 65 gallon capacity.

OPERATION AND MAINTENANCE

Both the Model QT 350A oil quench, and the Model QT 200A water quench systems circulate the quench media by means of an impeller type agitator. The impeller and motor assembly is removed from the top of the quench unit by first disconnecting the power from the unit to the field service panel, disconnecting the power lead and conduit from the control panel to the motor. Remove the four bolts in the corners of the motor base plate then lift the motor/impeller assembly clear of the quench unit.

The motor is totally enclosed, fan cooled, ball bearing, 1725 RPM, "C" flange, and is furnished in single, or poly phase service, as required. The motor bearings are permanently sealed and should require no more than normal maintenance. The lower impeller shaft bushing is a standard oilite bushing, easily replaced in the field.

TEMPERATURE OF WATER QUENCH MEDIA

The temperature of the water quench system is most effective when controlled at 65°-70°F. The most effective way of controlling the water temperature is by introducing fresh tap water. The QT 200A has a water inlet located in the top plate of the machine, so cold water is added directly into the pump reservoir. An overflow pipe drains the replaced water from the back of the QT 200A machine, so this unit must be installed where facilities are present to carry off the overflow. The water tap should be open just enough to hold the temperature below 80°F.

TEMPERATURE CONTROL QT 350A OIL QUENCH

Since most oil is a more effective quenchant at temperatures of 135°F., the QT 350A unit is equipped with electric element heaters, a temperature control instrument with high temperature cut off auziliary contacts, and two separate contactors. The first contactor is the line contactor, actuated by the high limit system, to cut all power to the heaters in case of temperature overshoot. The second contactor is the control contactor actuated by the temperature control instrument to maintain the pre-set temperature.

The control instrument is designed with two indicating lights. A green indicator will illuminate when the quenchant is below control point. When control temperature is reached, the light is off. A red light actuates when the quenchant reaches excess temperature. The high limit contacts are set to actuate when the temperature rises to 15% above the set temperature. Normal paraffin oil quenching temperature is usually set at 135°F. (*FOLLOW THE SUPPLIERS RECOMMENDATIONS.*) The auxiliary contacts drop the line contactor when oil temperature reaches 135°F. plus 20°F. or 155°F. The red indicator light will stay illuminated until quenchant temperature drops below 155°F., then it automatically resets the main contactor.

There may be times when the quenchant temperature will exceed the cut off limit due to continuous quenching. The overload contactor will actuate as stated above. *STOP QUENCHING UNTIL THE RED INDICATOR LIGHT IS EXTINGUISHED.*

The high limit contactors are set on a floating percentage basis. The factory preset percentage is 15% of set point. The floating percentage is constant, regardless of desired temperature setting. If the setting is 175°F., the cut off will be - plus 15% or approximately 200°F. *IT IS EXTREMELY IMPORTANT TO FOLLOW THE TEMPERATURE RANGES* set up by the quench oil supplier. Once the temperature is set by setting the control pointer, it should be secured with the scale lock in the lower right corner of the instrument housing.

Two additional adjustments are located on the face, or bezel of the instrument. The left side adjustment aligns the instrument temperature indicating needle with the control set point. The right adjustment is used to increase or decrease the floating percentage of the auxiliary set point. (allowable degrees of overshoot above set point) Additional information covering control instrumentation is shown in the manufacturer's manual.

REPLACING HEATING ELEMENTS QT-350A
(DISCONNECT ALL POWER TO MACHINE)

The sheathed electric heating elements are enclosed in an oil tight, sealed, cast aluminum box and are locked in position with oil tight brass fittings. Remove the cover of the element receptacle. Remove four hold down bolts located in each corner of the control panel. Withdraw the heating module from the quench chamber. Visual inspection will show blown or burned elements, but it is also advisable to check each heater element with a volt or ohmeter. Heaters showing an open circuit must be replaced. Refer to the heater Element Connector Diagram to reconnect the element leads. The heating elements are held in position with brass tank connector fittings which are similar to brass tubing connectors. Loosen the locknuts which hold the element and slide the element free.

Replace the defective heater elements, reconnect the power leads and reassemble the heater module to the quench tank. Be sure to replace all seals or gaskets to prevent leakage of quench media into the element module.

JOMINY QUENCH FIXTURE

MODEL JQF-1

FOR END QUENCH HARDENABILITY TESTING

The Jominy Quench Test has been used in industry for approximately forty years. It is used to determine whether various types of steel can develop specific physical properties by heat treatment. The test is simple to perform and gives positive results when properly done. It is a standard quality control test used by most large manufacturers of machinery and machine components. Most alloy and carbon steel producing mills use it as a means of certifying hardenability characteristics of their steel products.

JOMINY END QUENCH TESTING SHOULD BE A PART OF THE TRAINING IN EVERY METALLURGICAL TECHNOLOGY OR HEAT TREAT COURSE. Lab technicians must be familiar with its application and be able to perform accurate tests.

Test equipment was usually made by the personnel of each metals laboratory, since no commercial units were available. With the new emphasis on Metallurgical Technology in the Vocational Tech Schools and Universities, we feel the demand is now great enough to offer a unit developed by McEnglevan. These were custom designed and built in 1949/1950 for the quality control of a large manufacturer.

Years of use proved that a simple, yet dependable design was the most satisfactory. *EXPERIENCE ALSO PROVED THAT A SELF-CONTAINED, INTEGRAL UNIT WAS NECESSARY FOR ACCURATE AND CONSISTANT RESULTS.* Fluctuation in service line water pressure during the test, showed the importance of using a pump rather than connecting the test unit directly to a water line. Accurate tests cannot result without an even flow of water. The enclosed quenching chamber prevents uneven cooling of the test specimen by draft or air. Design of the quench bar support ring minimizes heat loss through the head of the specimen. A simple needle valve, with check rod, makes water column height adjustment test simple and accurate. This part of the test is extremely critical.

The JQF-1 fixture is a portable compact unit. It is built with a heavy stainless steel bracket, quench ring and nozzle. Fittings, pipe quenching chamber and adjusting valve are brass, to prevent rust and corrosion. The water pump rating is 5 GPM. at 8 Ft. head. It is powered by a 1500 RPM., 110 volt, 60 cycle motor, complete with power cord and plug. When used in a QT-200 system, the power receptacle and toggle switch are mounted in the main control panel. It is designed to be used with the QT-200A Quench unit, but can be used with a 10 gallon capacity tank, 16 inches long and 12 inches deep.

JOMINY END COOLED TEST FOR HARDENABILITY

Medium hardenability or common alloy steels are usually tested for hardenability by the end cooled method. This involves heating a test bar one inch in diameter, to the proper austenitizing temperature and then cooling only the end face with a controlled column of water. The hardness is then measured at intervals of 1/16 inch from the water cooled end to determine how far from this end the increased hardness extends. Figure 1 shows a standard test specimen.

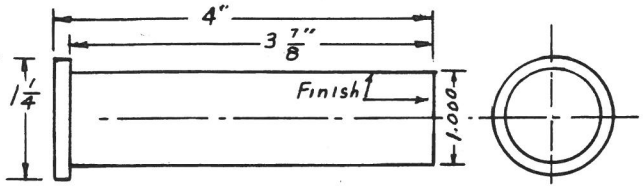


FIG. 1 STANDARD JOMINY TEST SPECIMEN

The test bar is normalized by heating it uniformly to about 150° F above the AC_3 point, then remove from the furnace and air cool to room temperature. Machine at least 1/8" from all surfaces to remove any decarburization and to obtain the correct dimensions. The specimen is then wrapped in a double layer of clean wrapping paper, and packed in clean cast iron chips in a closed clean container. The chips must be free from oil or residue. The paper prevents adhesion of the chips to the specimen during heating. The packed specimen is then heated to about 75° F above the AC_3 point and held at this temperature for 30 minutes after the pack box has reached furnace temperature. The pack is then taken from the furnace, the test specimen removed, and cooled immediately, in the Jominy fixture. Transfer time should not exceed a five second period.

The Jominy fixture is made so the test specimen is held 1/2 inch above a 1/2 inch diameter orfice, and the column of water flushes the bottom face of the piece. When preparing the fixture for testing, adjustment is made so the column of water rises 2-1/2 inches above the water orfice. Two 1/4 inch holes are drilled in the quench shield at the 2-1/2 inch height. By inserting a 1/4 inch round pin through the holes and across the shield, the water column height can be checked and adjusted so it rises to the pin. The pin is used only to check a column height. Water temperature should be between 70° and 80° F, and the quench shield maintains a condition of still air during cooling. The piece is quenched until cold, or for at least 10 minutes, and then may be quenched in cold water.

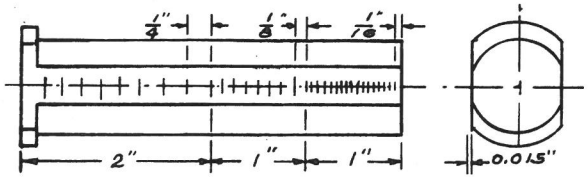


FIG. 2 LAYOUT OF HARDNESS CHECK FOR GROUND SPECIMEN

After cooling, two parallel flats 180° apart and 0.015 inch deep are surface ground along the entire length of the bar. Care should be taken to avoid overheating and tempering when grinding.

After grinding, the flats may be etched with 5% nital to determine if tempering has occurred.

Hardness measurements then taken at intervals of 1/16 inch for the first inch, then usually at 1/8 inch intervals for the second inch and 1/4 inch for the remainder of the bar. Refer to Figure 2. The hardness readings are then plotted to give a standard hardenability curve. Refer to Figure 3.

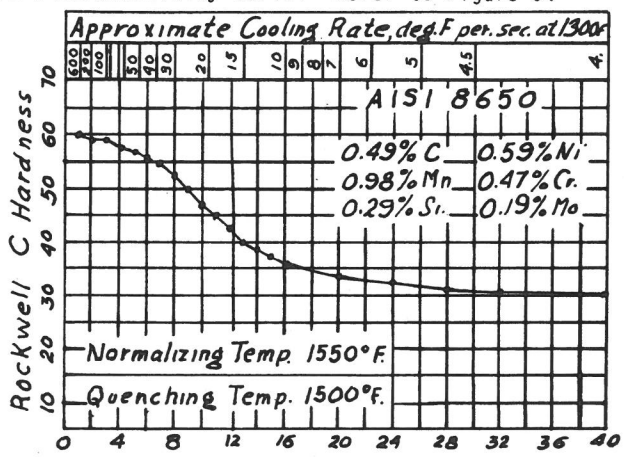


FIG. 3 TYPICAL END-QUENCH HARDENABILITY CURVE

If it is necessary to use specimens smaller than one inch in diameter, specimen may be machined to a dimension as shown in Figure 4, and inserted into a standard one inch bar that has been properly drilled. About 0.2 grams of low melting alloy is placed in the bottom of the hole and the bar is heated to about 212° F. The smaller specimen is then inserted into the hole, a small piece of asbestos is placed on the top of the insert, and the tong-hold piece is screwed down fairly tight.

The entire assembly is then heated to the austenitizing temperature and cooled in the standard manner. After the insert has been removed by the heating of about 212°F, hardness measurements are taken as they would be for a standard bar.

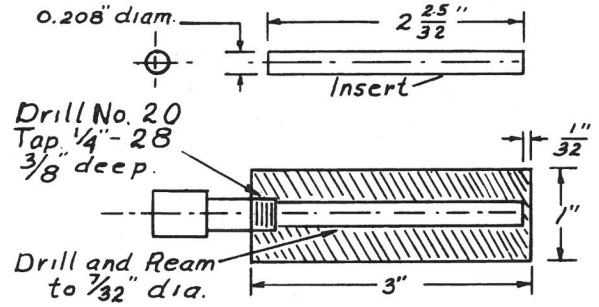


FIG. 4 INSERT TYPE SPECIMEN FOR SMALL SAMPLES

The McEnglevan Jominy Quench fixture is designed to be used with the QT-200A Mobile Water Quench tank. It is a portable fixture and is suspended in the quench chamber, with the pump immersed below the water level in the tank. By using the water in the quench tank, water temperature will usually be near room temperature, or between the required 70 to 80° F.

When using the Jominy fixture for quenching the specimen, first place the heated specimen in the fixture, then start the pump. The pump is equipped with a cord and male plug. The plug receptical and pump switch are located in the control panel of the quench tank.

The Jominy fixture can be purchased seperately and used in a suitable container which should have a minimum capacity of 20 gallons of water.

ELECTRICAL CHARACTERISTICS AND SPECIFICATIONS

The selection of field wire for incoming power shall be based on the following:

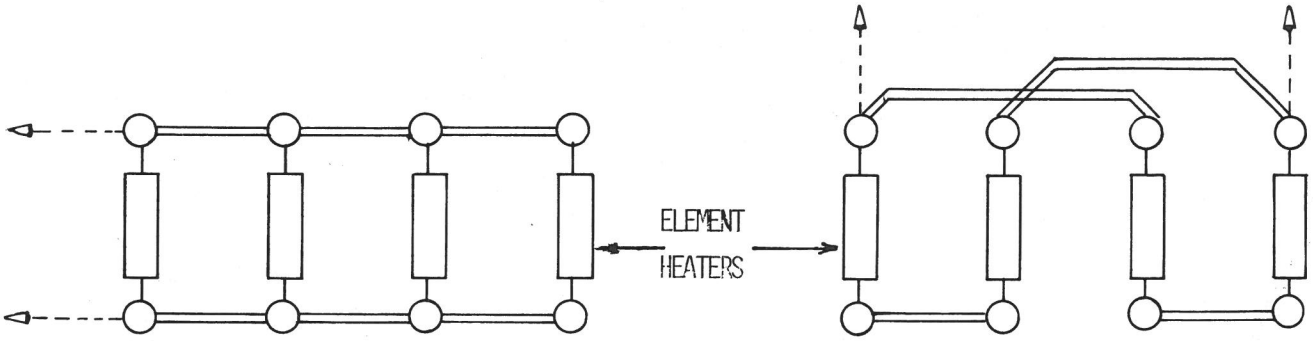
MINIMUM CIRCUIT AMPACITY:

		QT 200 A	QT 350 A
120 V. 1 Ph.	=	12.3 Amps	61.0 Amps
240 V. 1 Ph.	=	6.8 Amps	31.8 Amps
240 V. 3 Ph.	=	4.5 Amps	26.3 Amps
480 V. 3 Ph.	=	2.3 Amps	13.2 Amps

All units' replacement fuses shall be the Dual Element type to comply with N.E.C. Article 430-52-1975. All fuses are the MAXIMUM FUSE SIZE.

Use Diagram # _____ for field power connection or to trouble shoot the electrical system.

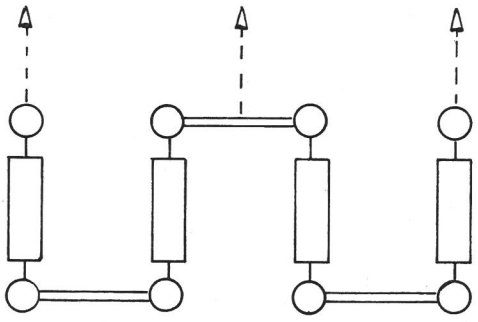
DIAGRAM FOR ELEMENT HEATER CONNECTIONS MODEL QT 350



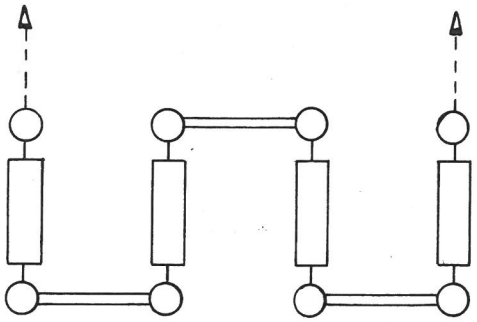
PARALLEL CONNECTION
FOR 120V-1PH DIAG. "U"

SERIES-PARALLEL CONNECTION
FOR 240V-1PH DIAG. "V"

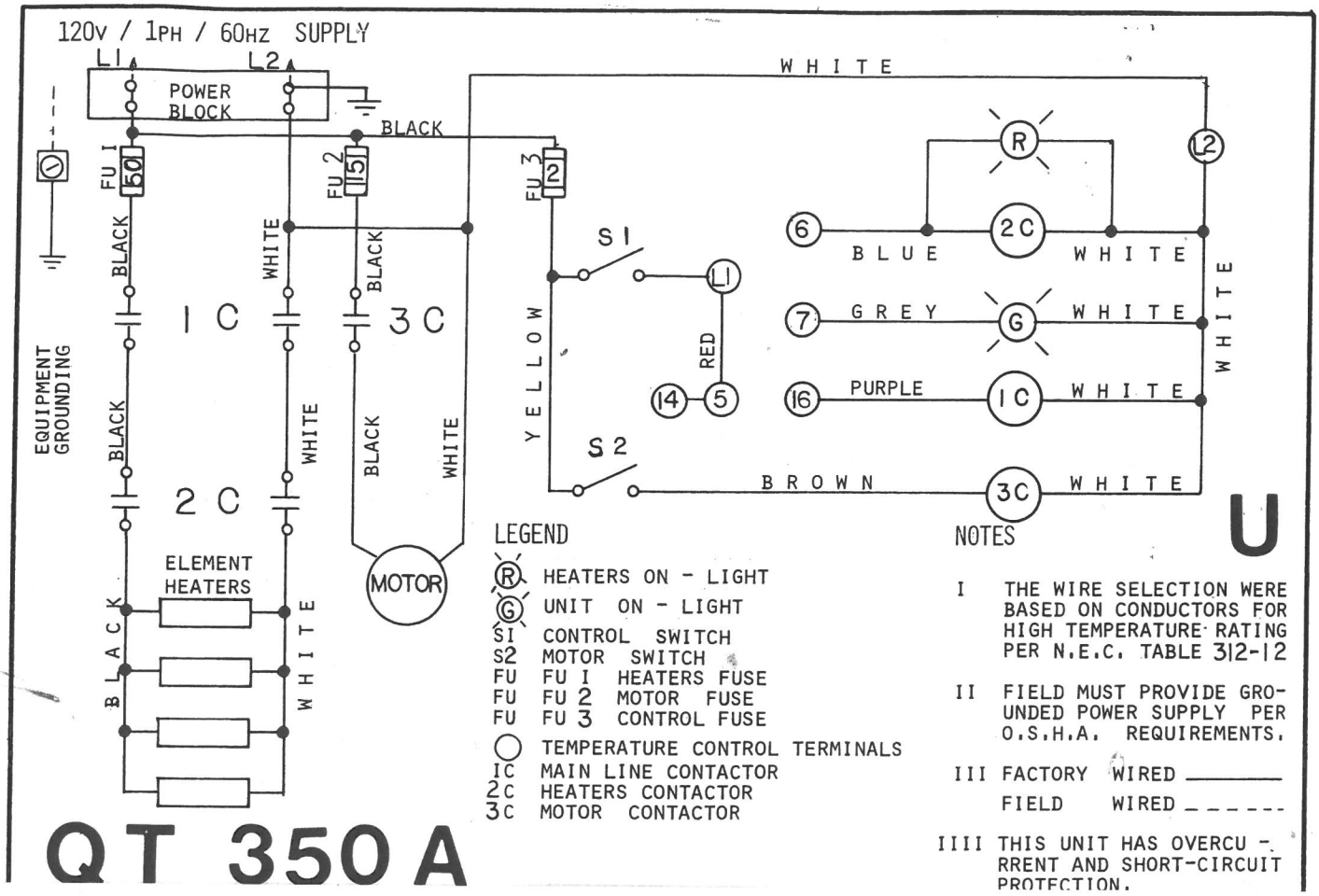
TYPICAL CONNECTIONS FOR QT 350 A WITH 120V. ELEMENT HEATERS



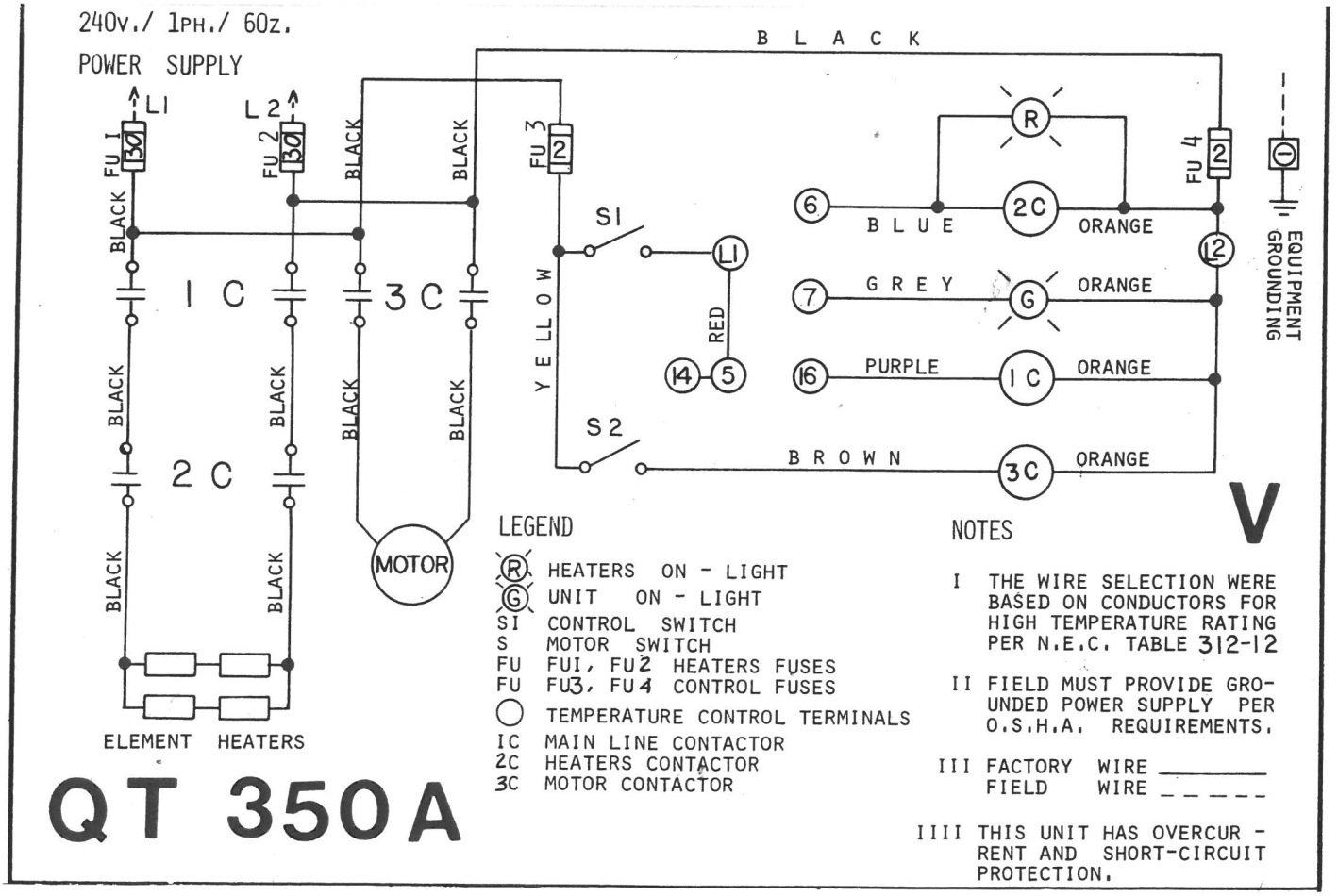
OPEN DELTA CONNECTION
FOR 240V-3PH DIAG. "W"

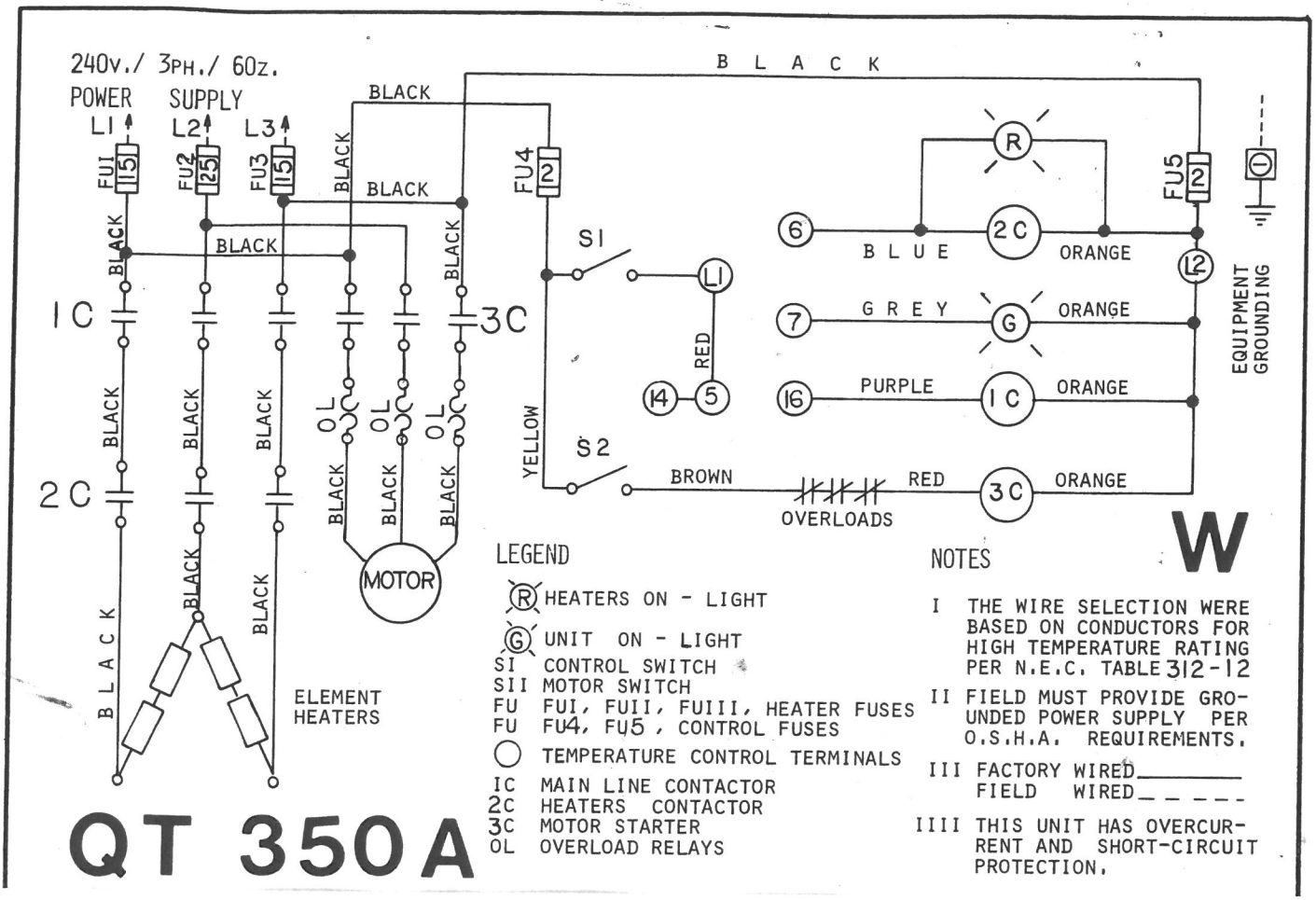


SERIES CONNECTION
FOR 480V-1PH DIAG. "X"

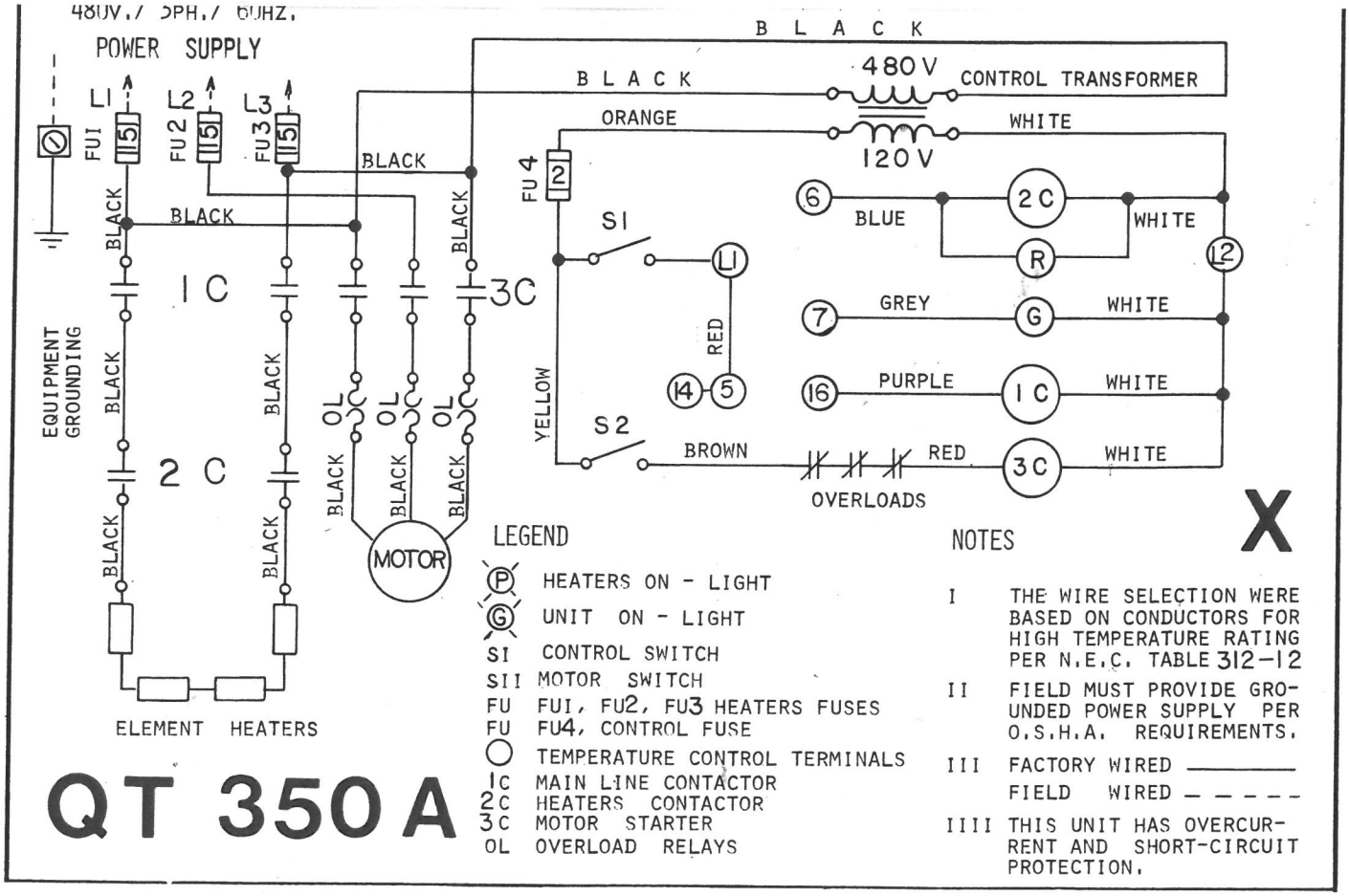


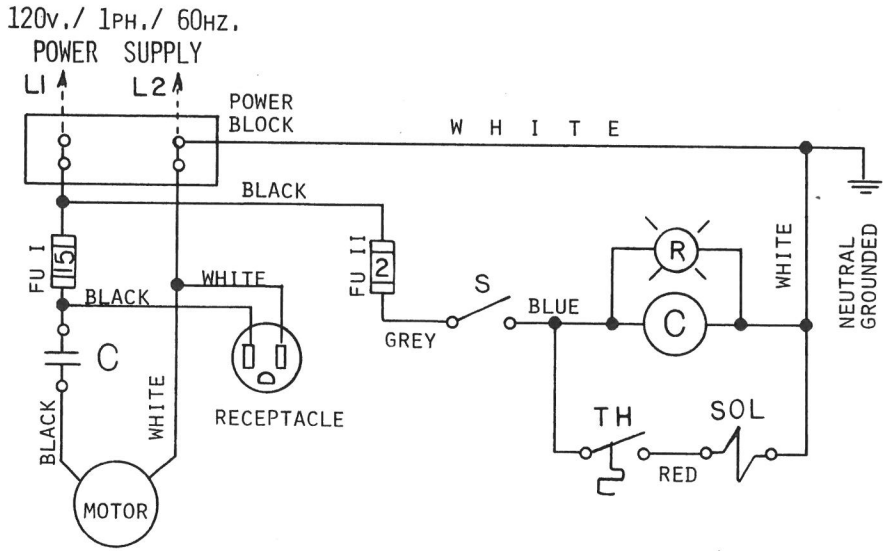
THESE DIAGRAMS ARE FOR OLDER UNITS ONLY – SEE LAST PAGE FOR CURRENT DIAGRAM





THESE DIAGRAMS ARE FOR OLDER UNITS ONLY – SEE LAST PAGE FOR CURRENT DIAGRAM





QT 200 A

LEGEND

(R)	UNIT ON - LIGHT
S	CONTROL SWITCH
TH	THERMOSTAT
SOL	WATER SOLENOID VALVE
C	MOTOR CONTACTOR
FUI	MOTOR FUSE
FUII	CONTROL FUSE

NOTES

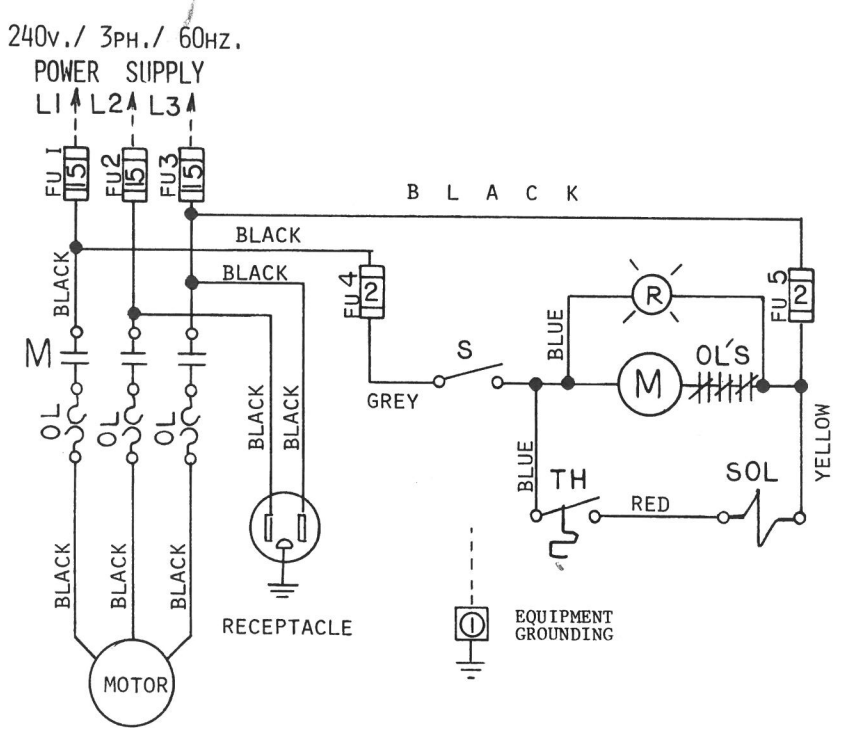
I THE WIRE SELECTION WERE BASED ON CONDUCTORS FOR HIGH TEMPERATURE RATING PER N.E.C. TABLE 312-12

II FIELD MUST PROVIDE GROUNDED POWER SUPPLY PER O.S.H.A. REQUIREMENTS.

III FACTORY WIRED _____
FIELD WIRED _ _ _ _ _ _

IIII THIS UNIT HAS OVERCURRENT AND SHORT-CIRCUIT PROTECTION.

Y



QT 200 A

LEGEND

(R)	UNIT ON - LIGHT
S	CONTROL SWITCH
TH	THERMOSTAT
SOL	SOLENOID VALVE
M	MOTOR STARTER
FU	FU1, FU2, FU3 MOTOR FUSES
FU	FU4, FU5, CONTROL FUSES
OL	OVERLOAD RELAYS

NOTES

I THE WIRE SELECTION WERE BASED ON CONDUCTORS FOR HIGH TEMPERATURE RATING PER N.E.C. TABLE 312-12

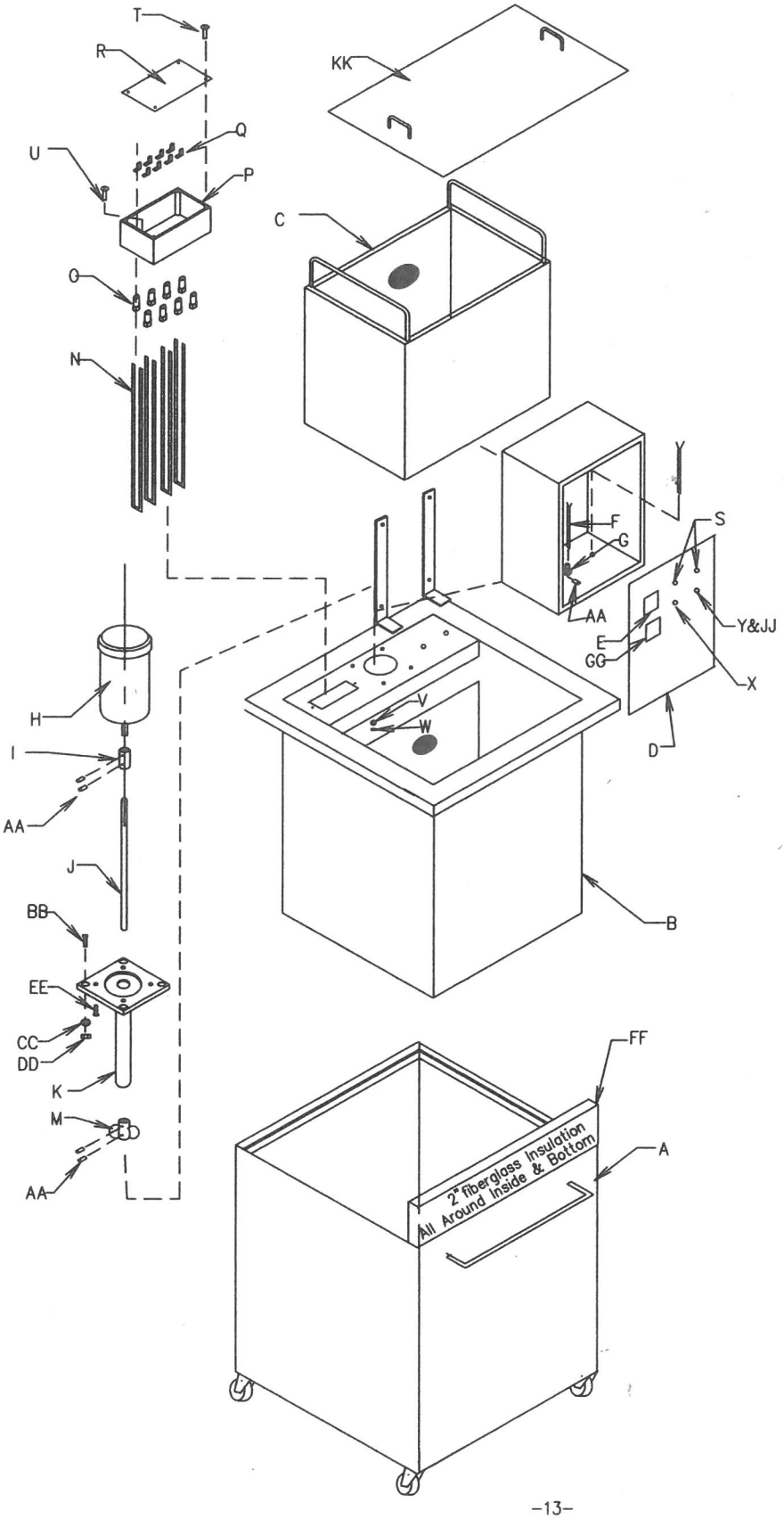
II FIELD MUST PROVIDE GROUNDED POWER SUPPLY PER O.S.H.A. REQUIREMENTS.

III FACTORY WIRED _____
FIELD WIRED _ _ _ _ _ _

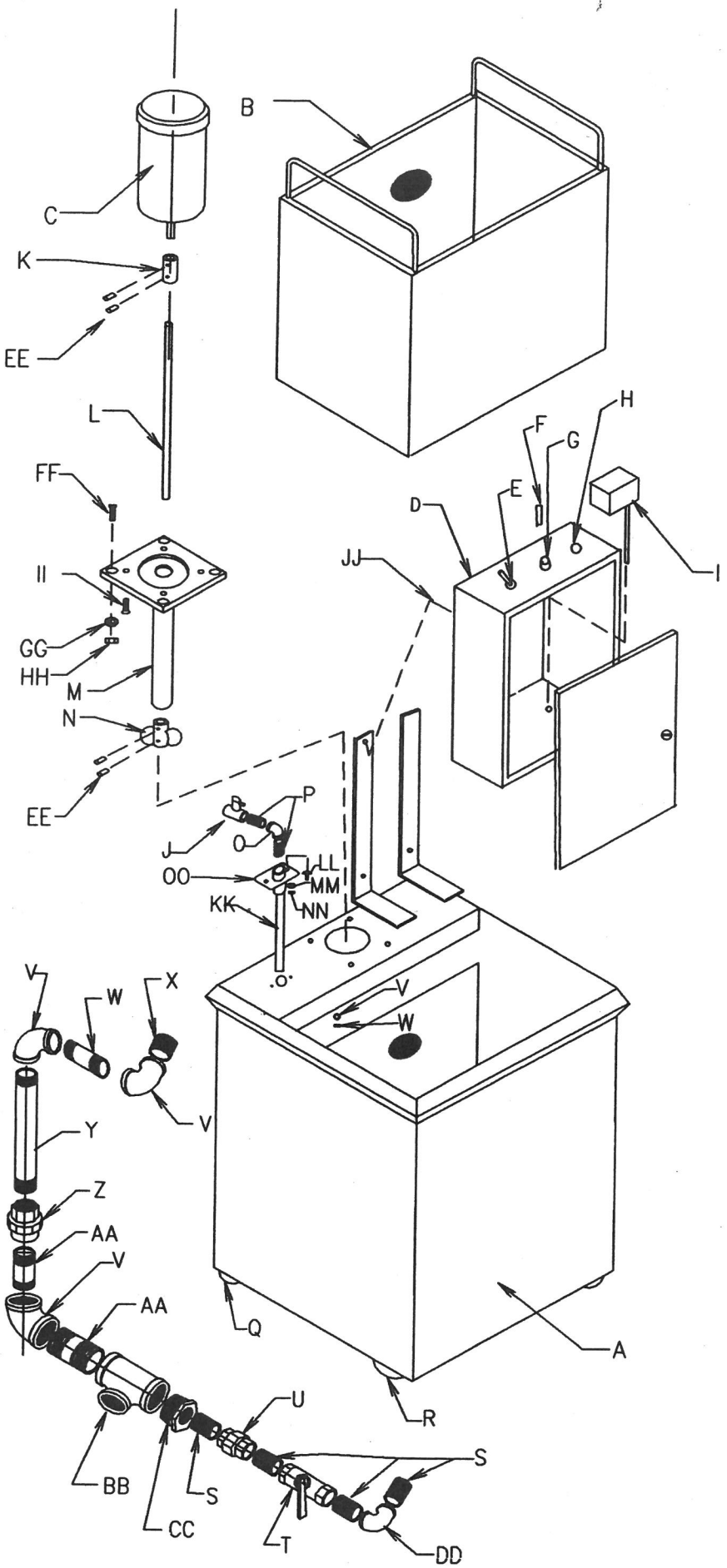
IIII THIS UNIT HAS OVERCURRENT AND SHORT-CIRCUIT PROTECTION.

Z

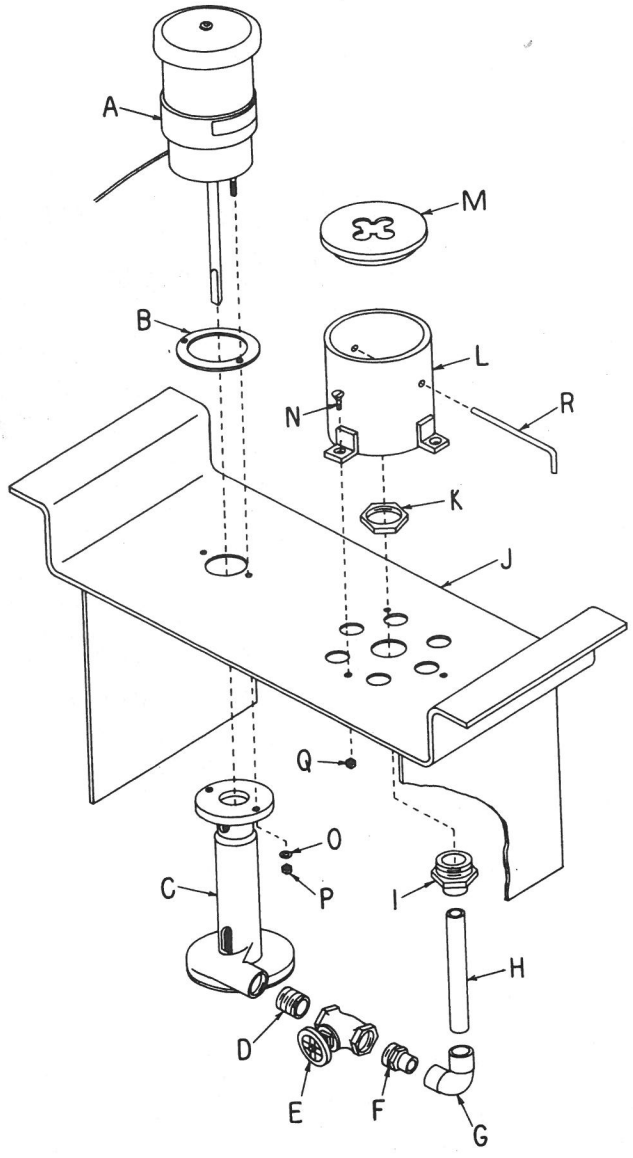
Diagrams for older units only



	QT350A Mobile Quench System 09/2018		
A	031531	Outer Tank Assembly	1
B	031540	Inner Tank Assembly	1
C	031500	Basket Assembly	1
D	003850	Hinged control box and	1
	PANEL	Panel	
E	004085	Watlow control Instrument	1
F	004045	15" Thermocouple	2
G	401856	Thermocouple Collar	2
H	004116	½ HP 1 ph motor	1
		Or	
	004119	½ HP 3 ph motor	1
I	002479	5/8" solid coupling	1
J	031513	5/8" Impeller Shaft	1
K	031570	Impeller Shaft Housing	1
M	031510	Impeller Assembly	1
N	004350	Shielded Heating Elements	4
O	003408	Compression Fitting	8
P	003858	Aluminum Enclosure Box	1
Q	003520	Copper Lugs	9
R	031591	Aluminum Enclosure Box Cover	1
S	003666	Toggle switch	2
T	000605	¼" x 5/8" Machine Screw	4
U	000606	¼" x ¾" Machine Screw	2
V	002122	3/8" Standard Lock Washer	2
W	002015	3/8" Hex Nut	2
X	003906	Red Indicator Light	1
Y	003624	5 amp fuse	1
AA	000802	¼" x 5/16" Set Screw	8
BB	001206	3/8" x 1 1/4" Hex Head Bolt	4
CC	002122	3/8" Lock Washer	4
DD	002015	3/8" Hex Nut	4
EE	001254	3/8"-16 x 1" FSLMS Screw	4
FF	008177	Tank Insulation 15'	
GG	004085	Watlow High Limit Instrument	1
II	000820	¼" x 3/8" Sq Hd Set Screw	1
		(not shown-for therm.holder)	
JJ	003600	Fuse Holder	1
KK	031562	Lid Assembly	1



	QT200A Mobile Quench System		
A	031461	Tank Assembly	1
B	031500	Basket Assembly	1
C	004116	½ HP 1 ph motor	
		Or	
	004119	1/2HP 3 ph motor	
D	003852	Control box 10x8x4 if 120v	1
	003886	Control box 12x10x5 if not 120v	
E	003666	Toggle Switch	1
F	003624	5 amp Fuse	1
G	003600	Fuse Holder	1
H	003906	Red Light	1
I	004035	Thermostat	1
J	004217	120v Water Solenoid Valve	1
K	002479	5/8" Solid Coupling	1
L	031513	5/8" Impeller Shaft	1
M	031570	Impeller Shaft Housing	1
N	031510	Impeller Assembly	1
O	003405	½" Galv Pipe Elbow	1
P	003403	½" Galv Close Nipple	2
Q	003505	3" Swivel (Comes with A)	2
R	003506	3" Fixed Wheel (Comes with A)	2
S	003091	1" Galv Close Nipple	4
T	003458	1" Valve	1
U	003501	1" Galv Std Union	1
V	003397	1 ½" Galv 90 deg elbow	3
W	003134	1 ½" x 4 ½" Galv Nipple	1
X	003111	1 ½" Close Galv Nipple	1
Y	003136	1 ½" x 17 ¼" Galv Nipple	1
Z	003491	1 ½" Galv Union	1
AA	003110	1 ½" x 3" Galv Nipple	2
BB	003281	1 ½" Galv Tee	1
CC	003332	1 ½" x 1" Galv Bushing	1
DD	003393	1" Galv 90 deg Elbow	1
EE	000802	¼" X 5/16" Set Screw	4
FF	001205	3/8" x 1" Hex Head Bolt	4
GG	002122	3/8" Lock Washer	4
HH	002015	3/8" Hex Nut	4
II	001382	3/8-16 x ¾" Flat Capscrew	4
JJ	000606	¼" x 3/4" Machine Screw	4
KK	031525	½" Galv Water Inlet Pipe	1
LL	000606	¼ x ¾" Machine Screw	2
MM	002111	¼" Standard Washer	2
NN	002008	¼" Hex Nut	2
OO	031467	Coupling Plate	1



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Makers of ***SPEEDY-MELT*** *Furnaces*

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JOMINY QUENCH FIXTURE

Model JQF-1

			Qty
A	031405	Pump Assy (Includes A,B,C,O,P)	1
B	------	Pump Gasket (Comes with A)	1
C	------	Pump (Comes with A)	1
D	003041	1/2" NPS Brass Close Nipple	1
E	004255	Stockham #B-64 1/2" Needle Valve	1
F	003494	1/2" Male Pipe to 5/8" OD Brass Sweat Fitting	1
G	003373	5/8" ID 90° Brass Elbow	1
H	003448	5/8" OD x 6 3/4" Copper Tubing	1
I	003490	Brass Bulk Head Fitting (Includes K)	1
J	031381	Stand Assembly	1
K	------	1 1/8" Brass Bulk Head Nut (Comes with I)	1
L	031390	Housing Assembly	1
M	031393	Housing Cover	1
N	000670	1/4" x 3/4" Brass Flat Head Machine Screw	3
O	------	#10 Washer (Comes with A)	2
P	------	#10-24 Nut (Comes with A)	2
Q	003492	1/4" Brass Nut	3
R	031394	1/4" Fountain Height Adjustment Rod	1

McENGLEVAN

JOMINY QUENCH FIXTURE

MODEL JQF-1

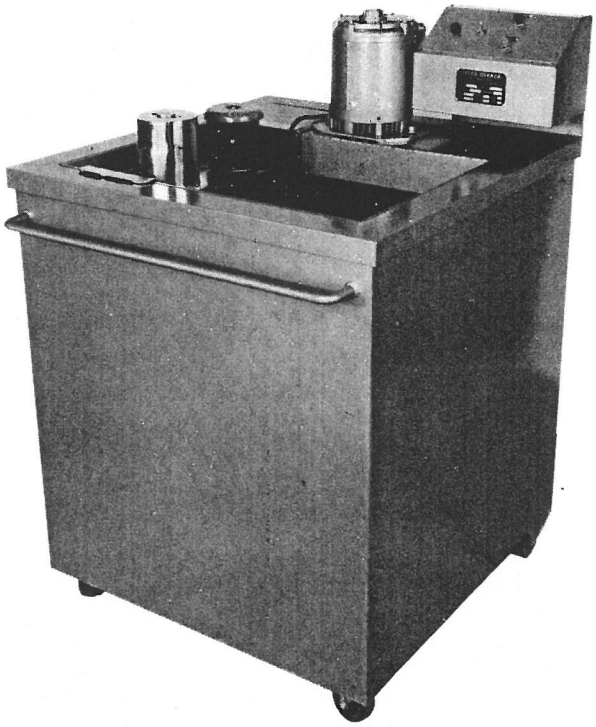
FOR END QUENCH HARDENABILITY TESTING

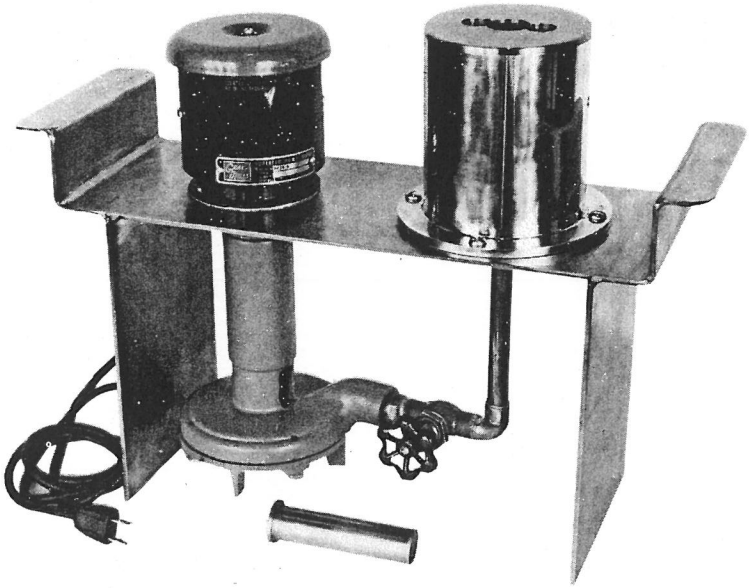
The Jominy End-Quench Fixture is used in metallurgical laboratories, to end quench steel test specimens to determine hardenability features of different analyses or types of steels used in manufacturing.

This practice is an essential part of all Industrial Quality Control programs used by large industry, and should be included in Vocational Metallurgical Technology in training curriculums.

The Model JQF-1 fixture is designed to be used with the QT-200-A Quench System, but can be used with any tank at least 16 in. wide by 12 in. deep. The tank should hold at least 10 gallons of water.

The illustration shows the fixture placed in the quench chamber of the QT-200A unit and set up to quench a test specimen.

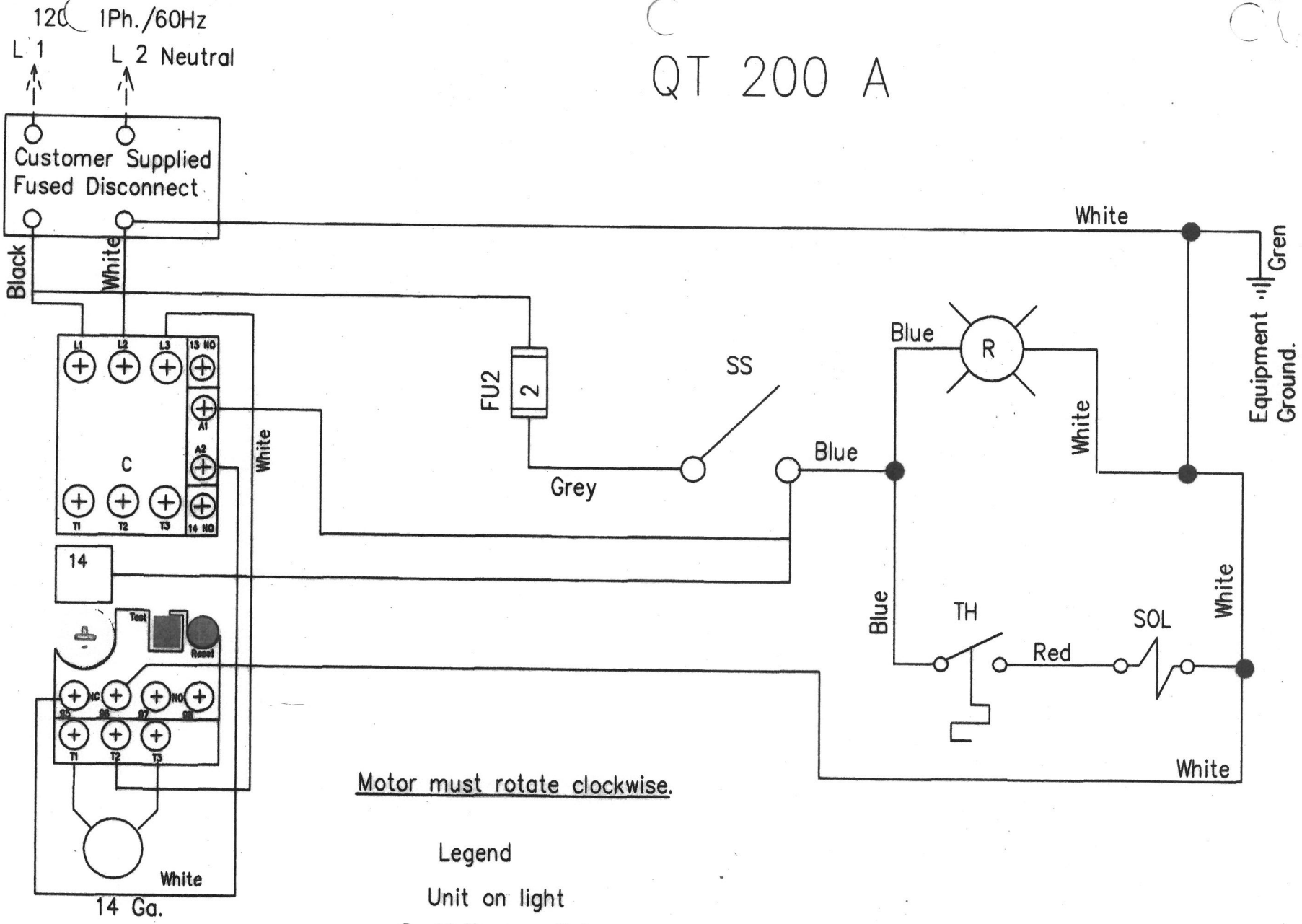




The JQF-1 fixture is a portable compact unit built with a heavy stainless steel bracket, quench ring and nozzle. Fittings, pipe quenching chamber and adjusting valve are brass to prevent rust and corrosion.

The water pump rating is 5 GPM. at 8 ft. head. It is powered by a 1500 RPM., 110 volt, 60 cycle motor, complete with power cord and plug. When used in a QT-200 system, the plug receptacle and switch are mounted in the main control panel.

QT 200 A



Motor must rotate clockwise.

Legend

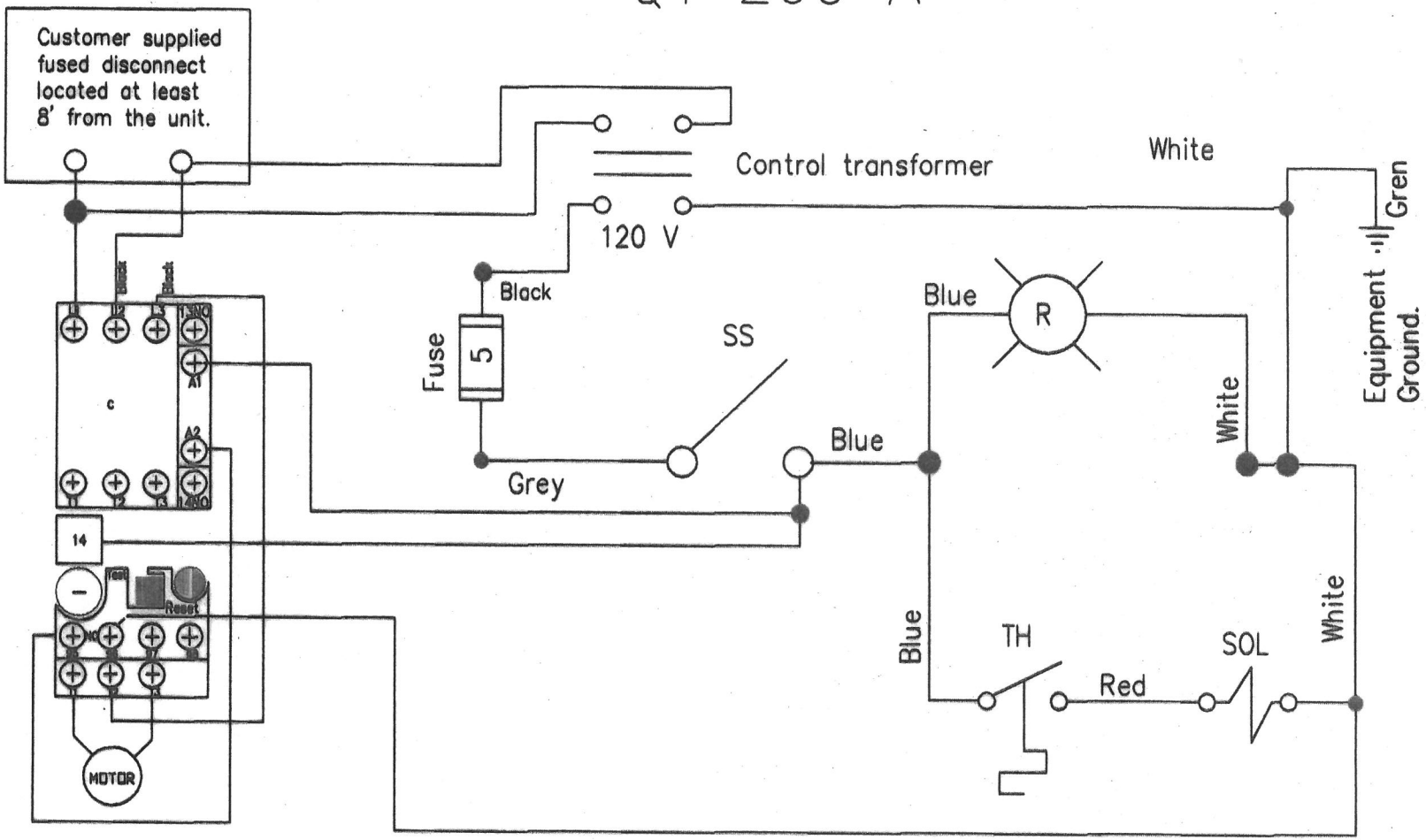
Unit on light

S Unit on switch
TH Thermostat
SOL Water solenoid
C Motor contactor
F 1 Motor fuse
F 2 Control fuse

ED0010	Drawn By Bill Walter
QT 200 A Water Quench System	
120V / 1 Ph / 60 Hz	
Mat.	
M I F C O	9/19/2002

220V / 1 Ph / 60 Hz

QT 200 A



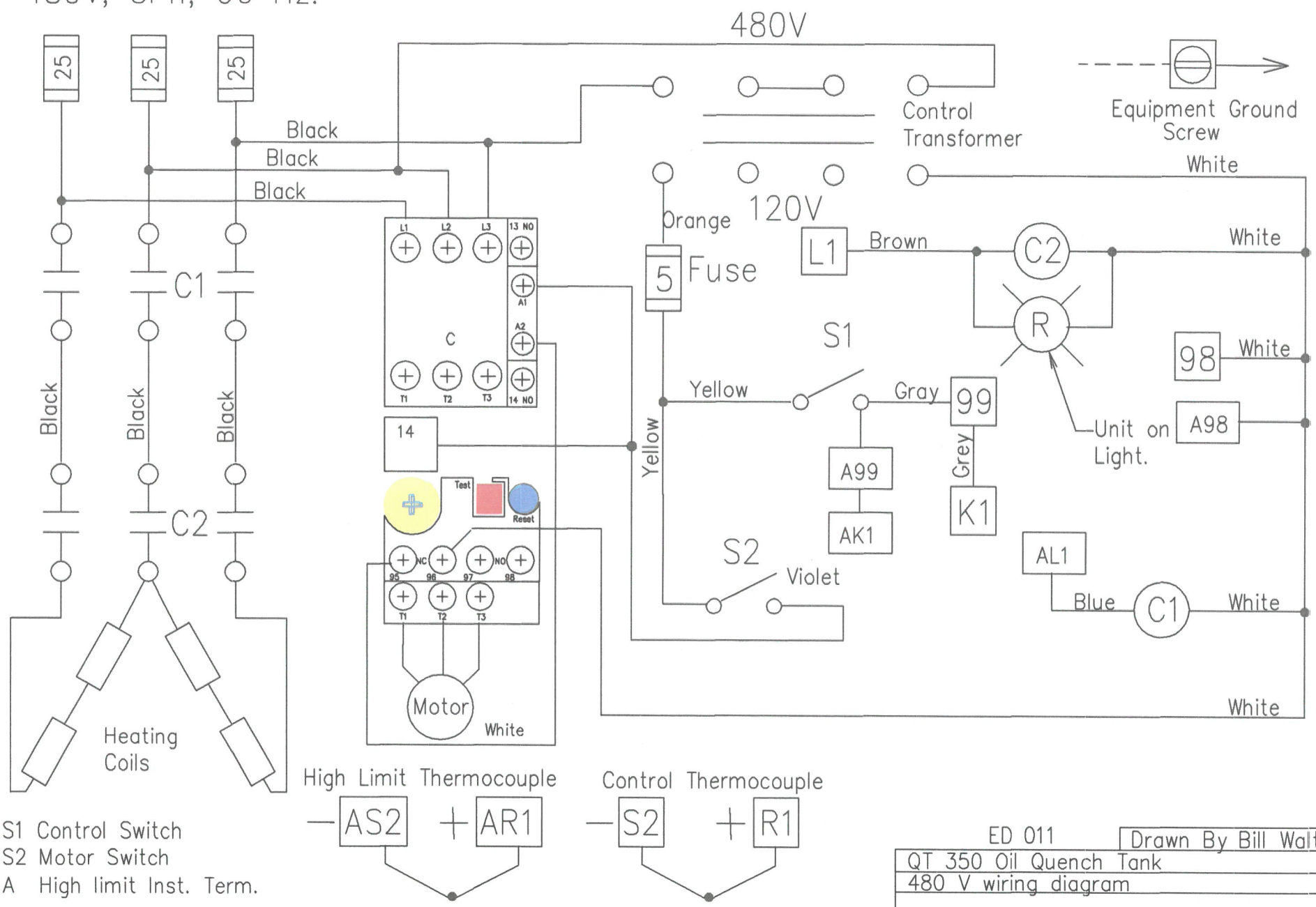
Legend

Unit on light

S Unit on switch
TH Thermostat
SOL Water solenoid
C Motor contactor
F 1 Motor fuse
F 2 Control fuse

ED006	Drawn By Bill Walter
QT 200 A Water Quench System	
220V / 1 Ph / 60 Hz	
Mat.	
M I F C O	9/19/2002

QT 350 A
With Watlow EZ Zone
480V, 3Ph, 60 Hz.



S1 Control Switch
S2 Motor Switch
A High limit Inst. Term.

ED 011	Drawn By Bill Walter
QT 350 Oil Quench Tank	
480 V wiring diagram	
M I F C O	9/19/2000