

**COMMERCIAL ELECTRIC
STORAGE HEATERS
125 thru 10,000
GALLON MODELS**

**limited warranty
installation
operation
maintenance
checklist**



LIMITED WARRANTY

A. O. Smith Corporation, the warrantor, extends the following LIMITED WARRANTY to the owner of this water heater:

1. THE TANK

If the glass-lined tank in this water heater shall prove upon examination by the warrantor to have leaked due to natural corrosion from potable water therein, during the first THREE years after initial installation, the warrantor will at its option, repair it or provide a replacement tank less elements and controls of equivalent size and then current model. Some government agencies are requiring energy efficient standards for water heaters. In the event regulations prohibit sale of a model of equivalent size and construction, A. O. Smith will provide a model which complies with the regulations of your area, in which case the consumer will be charged the difference in price between the like replacement and the energy efficient model required. The warranty on the repair or replacement of the part, portion or tank will be limited to the unexpired term of the original warranty.

2. ALL OTHER PARTS

If within ONE year after initial installation of this water heater, any part or portion shall prove upon examination by the warrantor to be defective in material or workmanship, the warrantor will repair or replace such part or portion at its option. The warranty on the repair or replacement of the part, portion or tank will be limited to the unexpired term of the original warranty.

3. CONDITIONS AND EXCEPTIONS

This warranty shall apply only when the water heater is installed in accordance with local plumbing and building codes, ordinances and regulations, the printed instructions provided with it and good industry practices. In addition, a temperature and pressure relief valve, approved by the American Society of Mechanical Engineers, must have been installed.

a. This warranty shall apply only when the heater is used:

- (1) at temperatures not exceeding the maximum setting of its control;
- (2) at water pressure not exceeding the working pressure shown on the water heater;
- (3) when filled with potable water, free to circulate at all times and with the tank free of damaging scale deposits;
- (4) in a non-corrosive and non-contaminated atmosphere;
- (5) in the United States, its territories or possessions, and Canada.

b. Any accident to the water heater, any misuse, abuse (including freezing) or alteration of it, any operation of it in a modified form, or any attempt to repair tank leaks will void this warranty.

4. SERVICE AND REPAIR EXPENSE

Under this limited warranty the warrantor will provide only repair or a replacement tank or part thereof. The owner is responsible for all other costs. Such costs may include but are not limited to:

- a. Labor charges for service, removal, repair, or reinstallation of the tank or any component part;
- b. Shipping, delivery, handling, and administrative charges for forwarding the new tank or replacement part from the nearest distributor and returning the claimed defective tank or part to such distributor.
- c. All cost necessary or incidental for any materials and/or permits required for installation of the replacement tank or part.

5. LIMITATION ON IMPLIED WARRANTIES

Implied warranties, including any warranty of merchantability imposed on the sale of this heater under state law are limited to one (1) year duration for the heater or any of its parts. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.

6. CLAIM PROCEDURE

Any claim under this warranty should be initiated with the dealer who sold the heater, or with any other dealer handling the warrantor's products. If this is not practicable, the owner should contact:

U. S. Customers except California

A. O. Smith Corporation
P. O. Box 28
Kankakee, Illinois 60901
Telephone: (815) 933-8241

California Customers Only

A. O. Smith Corporation
P. O. Box 484
Newark, California 94560
Telephone: (415) 792-1345

Canadian Customers

A. O. Smith Corporation
P. O. Box 310, 768 Erie Street
Stratford, Ontario, Canada N5A 6T3
Telephone: (519) 271-5800

- a. The warrantor will only honor replacement with identical or similar tank or parts thereof which are manufactured or distributed by the warrantor.
- b. Dealer replacements are made subject to in-warranty validation by warrantor.

7. DISCLAIMERS

NO OTHER EXPRESS WARRANTY HAS BEEN OR WILL BE MADE IN BEHALF OF THE WARRANTOR WITH RESPECT TO THE HEATER OR THE INSTALLATION, OPERATION, REPAIR OR REPLACEMENT OF THE TANK OR PARTS. THE WARRANTOR SHALL NOT BE RESPONSIBLE FOR WATER DAMAGE, LOSS OF USE OF THE UNIT, INCONVENIENCE, LOSS OR DAMAGE TO PERSONAL PROPERTY, OR OTHER CONSEQUENTIAL DAMAGE. THE WARRANTOR SHALL NOT BE LIABLE BY VIRTUE OF THIS WARRANTY OR OTHERWISE FOR DAMAGE TO ANY PERSONS OR PROPERTY, WHETHER DIRECT OR INDIRECT, AND WHETHER ARISING IN CONTRACT OR IN TORT.

- a. Some states do not allow the exclusion or limitation of the incidental or consequential damage, so the above limitation or exclusion may not apply to you.
- b. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Fill in the following for your own reference. Keep it. Registration is not a condition of warranty. The model and serial number are found on the heater's rating plate.

Model No. _____ Serial No. _____ Date Installed _____

Dealer's Name: _____

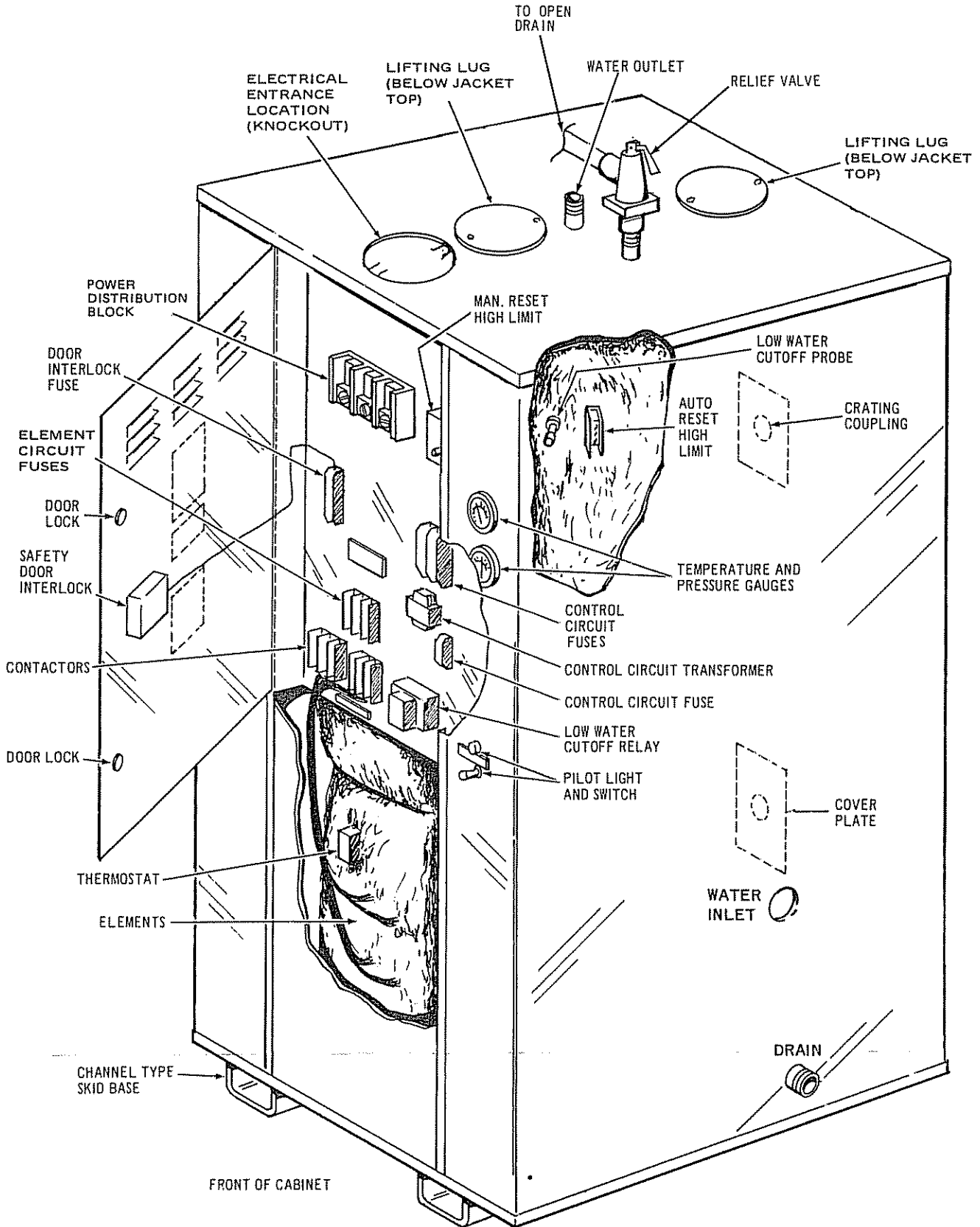
Dealer's Address: _____ Phone No. _____

City and State _____ Zip _____

KEEP THIS WARRANTY AND MANUAL POSTED ADJACENT TO THE HEATER FOR FUTURE REFERENCE WHENEVER MAINTENANCE, ADJUSTMENT OR SERVICE IS REQUIRED. BE SURE YOUR DEALER HAS FILLED IN THIS WARRANTY.

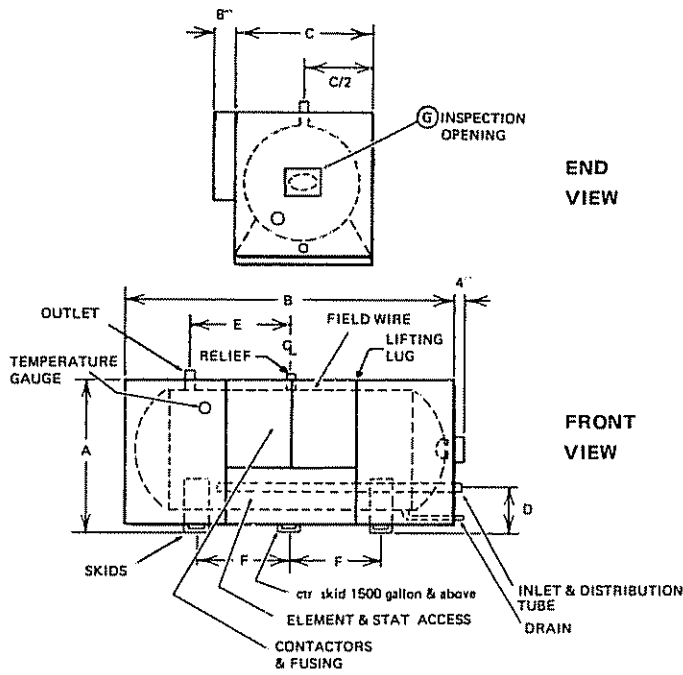
FEATURES

This is a typical vertical model heater. All of the features shown are not found on all models. Horizontal model heaters have similar features. The main difference is the tank is horizontally mounted instead of vertical as shown.

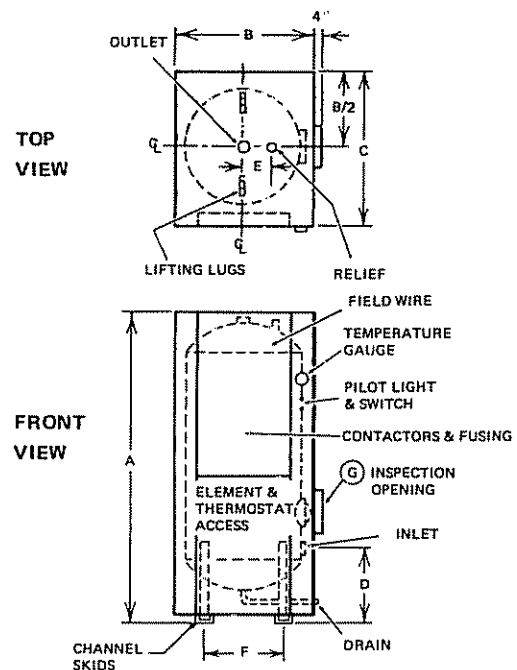


DIMENSIONAL DATA

HORIZONTAL MODELS



VERTICAL MODELS



ALL DIMENSIONS IN INCHES

A. O. SMITH MODEL*	NOMINAL GALLON CAPACITY	MAXIMUM KW INPUT	HEIGHT A	WIDTH (LENGTH) B	DEPTH C	D	E	SKID SPACING F	INSPECTION OPENING G	INLET OUTLET OPENING	RELIEF OPENING
HORIZONTAL ELECTRIC STORAGE HEATER											
DHE 200	200	180	38 1/2	77	36	10 1/2	17 1/2	18		1 1/2	3/4
DHE 250	250	240	38 1/2	91	36	10 1/2	24	24		1 1/2	1
DHE 300	300	300	44 1/2	81	42	8 1/4	17	18	N.A.	2	1
DHE 350	350	330	44 1/2	93	42	8 1/4	23	24		2	1
DHE 400	400	390	44 1/2	100	42	8 1/4	26 1/2	27 1/2		2	1
DHE 500	500	480	51	94	48	14	24	24	4" X 6"	2	1
DHE 600	600	600	51	109	48	14	32	32		2	1
DHE 700	700	690	51	121	48	14	38	38	Handhole	2	1
DHE 800	800	780	57	111	54	16 1/2	32	32		2	1
DHE 1000	1000	990	61	111	60	16 1/2	29 1/2	29 1/2		3	1
DHE 1250	1250	1200	61	138	60	16 1/2	43	43		3	1
DHE 1500	1500	1500	61	150	60	16 1/2	50	49	11" X 15"	3	1
DHE 2000	2000	1980	70	177	66	20	60	60	Manhole	3	1 1/4
DHE 3000	3000	3000	76	211	72	20	72 1/2	74		3	1 1/2
DHE 5000	5000	3000	82	296	78	20 1/2	113 1/2	115		3	1 1/2
DHE 7500	7500	3000	94	317	90	21 1/2	121	119		4	1 1/2
DHE 10,000	10,000	3000	106	345	102	22	132	130		4	1 1/2

VERTICAL ELECTRIC STORAGE HEATER

DVE 125	125	120	78 1/2	30	37	16	6	17		1 1/4	3/4
DVE 150	150	150	83 1/2	30	37	16	6	17		1 1/4	3/4
DVE 150L	150	150	59 1/2	36	43	17 1/2	6	21		1 1/4	3/4
DVE 200	200	180	79 1/2	36	43	17 1/2	6	21		1 1/2	3/4
DVE 250	250	240	93	36	43	17 1/2	6	21	N.A.	1 1/2	1
DVE 300	300	300	83 1/2	42	49	19	6	25 1/2		2	1
DVE 350	350	330	95 1/2	42	49	19	6	25 1/2		2	1
DVE 400	400	390	102 1/2	42	49	19	6	25 1/2		2	1
DVE 500	500	480	97	48	55	21	6	30	4" X 6"	2	1
DVE 600	600	600	112	48	55	21	6	30		2	1
DVE 700	700	690	124	48	55	21	6	30	Handhole	2	1
DVE 800	800	780	116	54	61	23	8	34		2	1
DVE 1000	1000	990	116	60	67	24 1/2	10	38		3	1
DVE 1250	1250	1200	143	60	67	24 1/2	10	38	11" X 15"	3	1
DVE 1500	1500	1500	155	60	67	24 1/2	10	38		3	1
DVE 2000	2000	1980	183	66	73	25	12	42 1/2	Manhole	3	1
DVE 3000	3000	3000	217	72	79	27 1/2	14	47		3	1 1/2
DVE 5000	5000	3000	309	78	85	30	14	51		3	1 1/2
DVE 7500	7500	3000	330	90	97	30	14	59 1/2		4	1 1/2
DVE 10,000	10,000	3000	358	102	109	30	14	68		4	1 1/2

* Complete Model Number includes the desired KW at end. e.g : DVE500-120 when KW = 120.

Minimum Installation Clearances Required: 30" from Front, 12" from Top, and 24" from Right Side

ELECTRICAL/RECOVERY DATA

STANDARD KW INPUTS

Standard KW Ratings	Number of Heat Elements	BTU Input & Output	GPH Recovery 100°F Rise	Number of 50A Contactors		Amperage Draw			
				Three-Phase	Three-Phase	Three-Phase			
				208V, 240V	480V, 600V	208V	240V	480V	600V
15	1-15KW	51,195	61	1	1	42	37	19	15
24	2-12KW	81,912	98	2	1	67	58	27	23
30	2-15KW	102,390	123	2	1	83	72	36	29
36	3-12KW	122,868	147	3	1	100	87	43	35
45	3-15KW	153,585	184	3	2	125	109	54	44
60	4-15KW	204,720	246	4	2	167	145	72	58
75	5-15KW	255,975	307	5	3	208	181	90	72
90	6-15KW	307,170	369	6	3	250	217	109	87
105	7-15KW	358,365	430	7	4	292	253	127	101
120	8-15KW	409,560	492	8	4	333	289	145	115
150	10-15KW	511,950	615	10	5	416	361	180	144
190	12-15KW	614,340	738	12	6	499	433	217	173
210	14-15KW	716,730	861	14	7	583	505	253	202
240	16-15KW	819,120	984	16	8	666	577	289	231
270	18-15KW	921,510	1,107	18	9	750	650	325	260
300	20-15KW	1,023,900	1,230	20	10	832	722	361	289
330	22-15KW	1,126,290	1,353	22	11	916	794	397	318
360	24-15KW	1,228,680	1,476	24	12	999	866	433	346
390	26-15KW	1,331,070	1,599	26	13	1,083	938	469	375
420	28-15KW	1,433,460	1,722	28	14	1,166	1,010	505	404
450	30-15KW	1,535,850	1,845	30	15	1,249	1,083	542	433
480	32-15KW	1,638,240	1,968	32	16	1,332	1,155	578	462
510	34-15KW	1,740,630	2,091	34	17	1,416	1,227	613	491
540	36-15KW	1,843,020	2,214	36	18	1,499	1,299	650	520
570	38-15KW	1,945,410	2,337	38	19	1,582	1,371	686	548
600	40-15KW	2,047,800	2,460	40	20	1,664	1,443	722	577
630	42-15KW	2,150,190	2,583		21			758	606
660	44-15KW	2,252,580	2,706		22			794	635
690	46-15KW	2,345,970	2,829		23			830	664
720	48-15KW	2,457,360	2,952		24			866	693
810	54-15KW	2,764,530	3,321		27			974	779
900	60-15KW	3,071,700	3,690		30			1,083	866
990	66-15KW	3,378,870	4,059		33			1,191	953
1080	72-15KW	3,686,040	4,428		36			1,299	1,039
1170	78-15KW	3,993,210	4,797		39			1,408	1,126
1260	84-15KW	4,300,380	5,166		42			1,516	1,213
1350	90-15KW	4,607,550	5,535		45			1,624	1,300
1440	96-15KW	4,914,720	5,904		48			1,732	1,386
1530	102-15KW	5,221,890	6,273		51			1,841	1,473
1620	108-15KW	5,529,060	6,642		54			1,949	1,559
1800	120-15KW	6,141,600	7,380		60			2,170	1,732
1980	132-15KW	6,757,740	8,118		66			2,382	1,905
2040	136-15KW	6,962,520	8,364		68			2,454	1,963
2220	148-15KW	7,576,860	9,102		74			2,670	2,136
2250	150-15KW	7,679,250	9,225		75			2,707	2,165
2400	160-15KW	8,188,800	9,840		80			2,887	2,310
2640	176-15KW	9,010,320	10,824		88			3,175	2,540
2820	188-15KW	9,624,660	11,562		94			3,392	2,714
3000	200-15KW	10,236,000	12,300		100			3,608	2,887

NOT RECOMMENDED

NOT RECOMMENDED

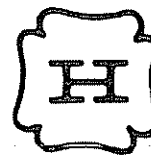
APPROVALS

All models are listed by Underwriters' Laboratories, Inc. and bear their label.



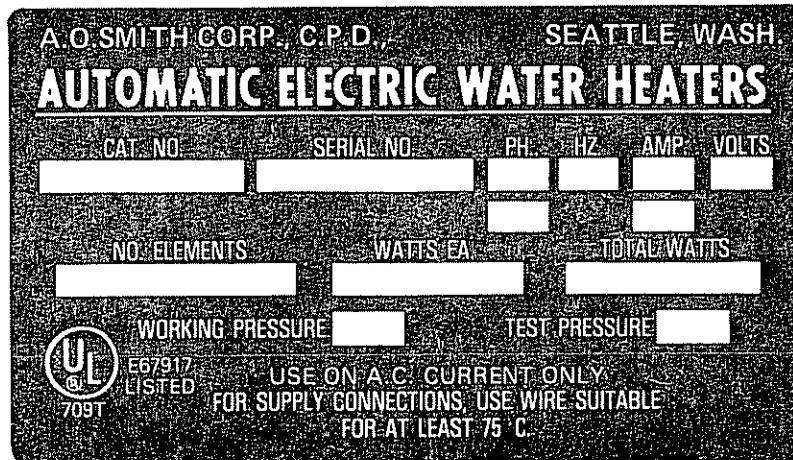
OPTIONAL

STANDARD



All models are built to the standards of Section IV of the American Society of Mechanical Engineers, inspected and identified by either of these symbols. Where specified, the National Board of Boiler and Pressure Vessel Inspectors listing is furnished. The NB number is stamped on the ASME plate.

MODEL AND RATING PLATE



CRATING/HANDLING

All heaters are shipped in strong, steel banded crates. Extreme care must be used in handling as shipping weights range from 635 to 6000 pounds or more depending upon options.

Vertical heaters are in crates built for vertical or horizontal handling. On one side of 250 gallon size heaters, a crate cross slat is braced to

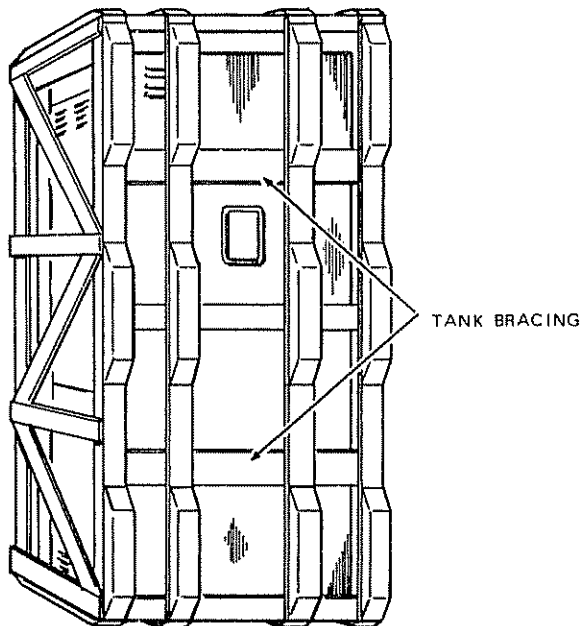
the tank through an opening in the rear cabinet panel. Larger size heaters have an upper and a lower brace. On the same side as the braces, the crate slats are equipped with blocks to permit handling in a horizontal position with a fork truck.

Horizontal model heaters are crated for horizontal shipment only.

Crated heaters may be handled by mechanical means on the bottom and side as previously described. In addition, some heaters have two permanently attached lifting lugs accessible through the top crate slats. The lugs may be utilized by a crane or rigging equipment. Move the heater as close as possible to the installation site in the crate.

Out of the crate, the heater skid type base is sturdy enough for handling and shimming.

If stored before installation, the heater should be placed in a dry atmosphere, free of temperature extremes, to minimize condensation on electrical components.



BACK OF CRATE

SAFETY

Be sure to turn off power when working on or near the electrical system of the heater. Never touch electrical components with wet hands or when standing in water. When replacing fuses always use the correct size for the circuit.

INSTALLATION

REQUIRED ABILITY

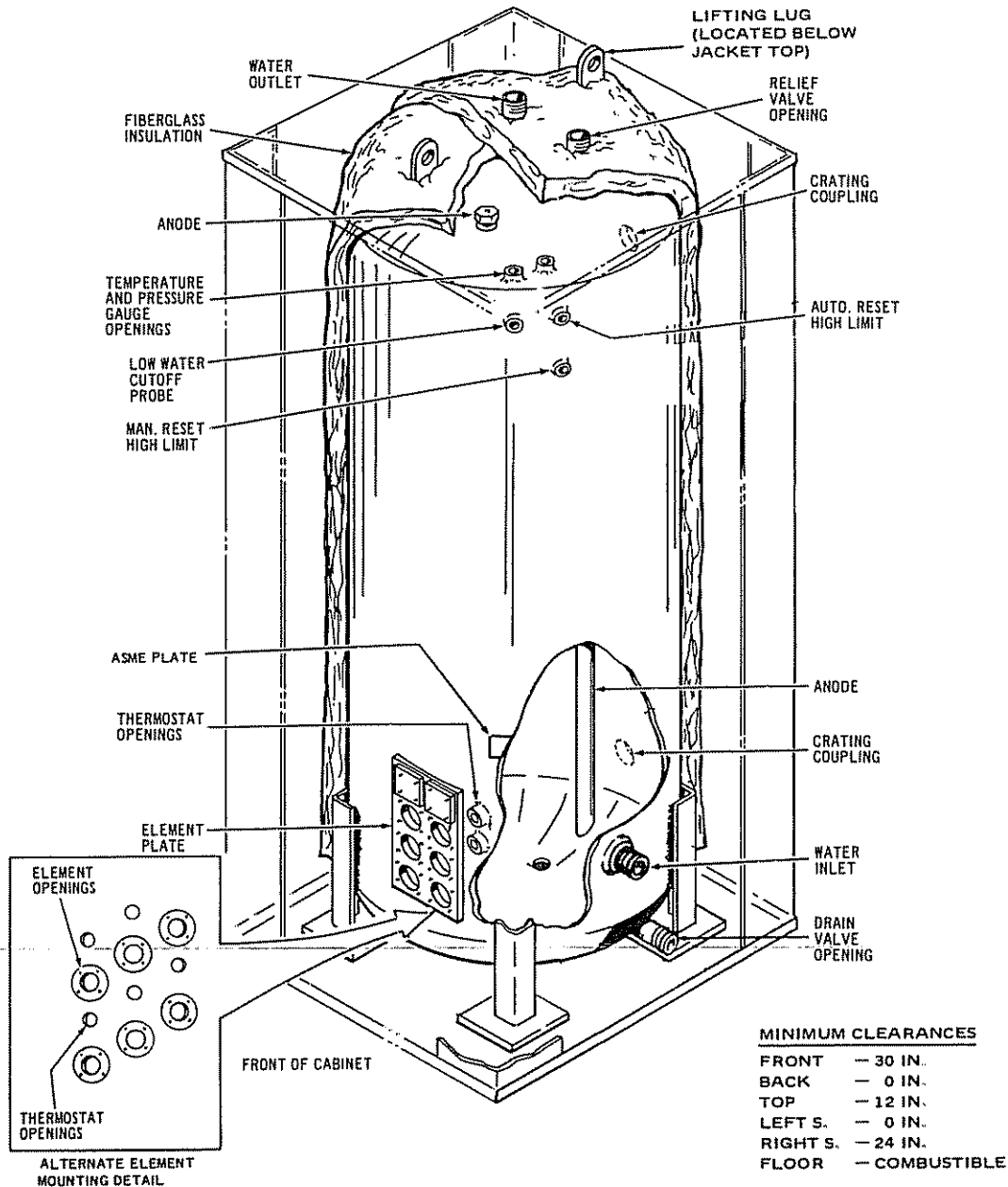
INSTALLATION OR SERVICE OF THIS WATER HEATER REQUIRES ABILITY EQUIVALENT TO THAT OF A LICENSED TRADESMAN IN THE FIELD INVOLVED. PLUMBING AND ELECTRICAL WORK ARE REQUIRED.

and electrical wiring connected to the water heater must also conform to the NATIONAL ELECTRICAL CODE NFPA-70-1981. Copies of this code may be obtained from American National Standard Institute, 1430 Broadway, New York, NY 10018.

GENERAL

The installation must conform to these instructions and the local code authority having jurisdiction. Grounding

Do not test electrical system before heater is filled with water, follow START UP procedure in this manual.



The principal components of the heater are identified in a picture on page 2. The model and rating plate illustration on page 5 interprets certain markings into useful information. Both of these references should be used to identify the heater, its components and optional equipment.

Chemical Vapor Corrosion

Water heater corrosion and component failure can be caused by the heating and breakdown of air borne chemical vapors. Spray can propellants, cleaning solvents, refrigerator and air conditioning refrigerants, swimming pool chemicals, calcium and sodium chloride, waxes, and process chemicals are typical compounds which are potentially corrosive. These materials are corrosive at very low concentration levels with little or no odor to reveal their presence.

Products of this sort should not be stored near the heater. Also, air which is brought in contact with the water heater should not contain any of these chemicals. If necessary, uncontaminated air should be obtained from remote or outside sources.

LOCATION

For the best installation, the water heater should be located:

1. On a level surface.
 - Shim the channel type skid base as necessary if levelling is required.
2. Near a floor drain.
 - The heater should be located in an area where leakage of the tank or connections will not result in damage to the area adjacent to the heater or to lower floors of the structure.

When such locations cannot be avoided, a suitable drain pan should be installed under the heater.

The pan should be at least two inches deep, have a minimum length and width of at least two inches greater than the diameter of the heater and should be piped to an adequate drain.

- The discharge opening of the relief valve should always be piped to an open drain.
3. Close to the point of major hot water usage and the power supply.
 - Try to make hot water piping and branch circuit wiring as short as possible.
 - Insulate hot and cold water piping where

heat loss and condensation may be a problem.

Heater construction permits installation, maintenance and service work to be performed through the front and right side openings.

Suggested clearances from adjacent surfaces are one foot on top, 30 inches in front and two feet on right side for access to the unit.

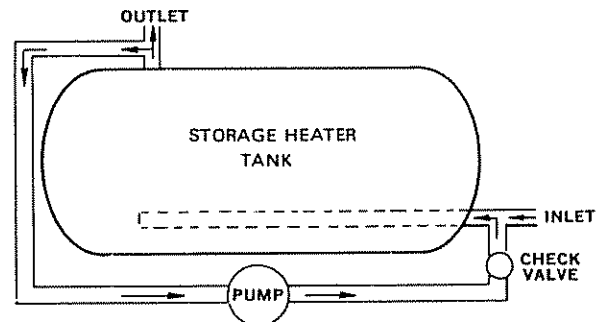
The heater may be installed on or against combustible surfaces. The left side and back may be placed flush against adjacent surfaces. Be sure to place the cover plates over the rear crating couplings before locating vertical model heaters. The heater may be installed in a confined space if adequate ventilation is provided.

The temperature of the space in which the heater is installed must not go below 32°F or above 122°F.

CIRCULATING PUMP

Field installed circulating pumps should be of all bronze constructions.

To optimize the total storage capacity of a horizontal vessel, particularly under low draw conditions, it is recommended to utilize a pump and recirculation line sized to turn the entire storage capacity of the tank once each hour (i.e., a 600 gallon tank would require a 10 gpm pump).



RELIEF VALVE

An ASME rated temperature and pressure relief valve is installed on the heater. A drain line from this valve should terminate near a suitable drain. Do not thread, plug or cap the end of the drain line

The pressure setting of the relief valve should not exceed the pressure capacity of any component in the system including the water heater. The temperature setting of the relief valve should not exceed 210° F.

HIGH TEMPERATURE DEVICES

Automatic Device

The heater control circuit contains a high temper-

ature cutoff switch. This device shuts off the heating elements if excessive water temperatures are reached. The high temperature cutoff contacts open at 190°F and reclose automatically after a drop in water temperature.

Manual Device

A manual reset high limit is in the control circuit in addition to the automatic device previously described. The contacts open at 200°F and must be manually reset after a drop in water temperature.

The reset button is located in the control compartment of the heater. Disconnect the power before opening the door to push the button.

ELECTRICAL

General

Check the heater model and rating plate information against the characteristics of the branch circuit electrical supply. Do not connect the heater to an improper source of electricity. Contact the heater supplier for conversion information if necessary.

Voltage applied to the heater should not vary more than +5% to -10% of the model and rating plate marking for satisfactory operation.

Do not energize the branch circuit for any reason before the heater tank is filled with water. Doing so may cause the heating elements to fail.

The factory wiring is attached to a terminal block on the unit. The branch circuit is connected to the block through an opening provided on the heater. Factory terminal block has 500 MCM maximum copper wire size capacity in each opening. If apparent field wire size is over 500 MCM multiple terminal blocks will be furnished. If other opening sizes are desired they should be specified when unit is ordered.

The water heater should be connected to a separate, grounded, branch circuit with overcurrent protection and disconnect switch. The water heater should be grounded in accordance with national and local codes.

Branch Circuit

The branch circuit wire size should be established through reference to the National Electrical Code or other locally approved source in conjunction with the heater amperage rating. Wire rated at 75°C should be used. For convenience, portions of the wire size tables from the Code are reproduced in the next column. It is suggested the electrician size the branch circuit at 125 percent of the heater rating and further increase wire size as necessary to compensate for voltage drop in long runs. Voltage drop should not exceed 3% at end of run.

BRANCH CIRCUIT WIRE SIZE TABLE

Portion of Table 310-16
Allowable Ampacities of Insulated Copper Conductors

Not More than Three Conductors in Raceway or Cable or Direct Burial (Based on Ambient Temperature of 30°C / 86°F.)

Size	Temperature Rating of Conductor. See Table 310-13 in Code
AWG	75°C (167°F)
MCM	TYPES RH, RHW, RUH (14-2), THW, THWN, XHHW, USE
18	1
16	2
14	3
12	4
10	5
8	6
6	7
4	8
3	9
2	10
1	11
1/0	12
2/0	13
3/0	14
4/0	15
250	16
300	17
350	18
400	19
500	20
600	21
700	22
750	23
800	24
900	25
1000	26
1250	27
1500	28
1750	29
2000	30

Portion of Table 310-16
Allowable Ampacities of Insulated Aluminum and Copper-Clad Aluminum Conductors

Not More than Three Conductors in Raceway or Cable or Direct Burial (Based on Ambient Temperature of 30°C / 86°F.)

Size	Temperature Rating of Conductor. See Table 310-13 in Code
AWG	75°C (167°F)
MCM	TYPES RH, RHW, RUH (12-2), THW, THWN, XHHW, USE
12	1
10	2
8	3
6	4
4	5
3	6
2	7
1	8
1/0	9
2/0	10
3/0	11
4/0	12
250	13
300	14
350	15
400	16
500	17
600	18
700	19
800	20
900	21
1000	22
1250	23
1500	24
1750	25
2000	26

These ampacities relate only to conductors described in Table 310-13 in Code. For ambient temperatures over 30°C, see Correction Factors. Note 13 in Code.

Calculating Amperage/Overcurrent Protection

The heater is factory wired for connection to three wire single-phase or three wire three-phase branch circuits. A neutral wire is required on 208 volt single and three-phase and 240 volt single-phase units. In addition a ground conductor may be required.

A diagram of the wiring is furnished with the water heater for the electrician's use. An amperage table is on page 4 of this manual. When necessary, amperage is calculated as follows:

Single-phase:

$$(1) \text{ Wattage} \div \text{Voltage} = \text{Amperage}$$

Three-phase:

$$(1) \text{ Wattage} \div \text{Voltage} \times .577 = \text{Amperage}$$

Amperage is used to establish branch circuit conductor and overcurrent protection size.

The rating of the overcurrent protection should be computed on the basis of 125 percent of the total connected load amperage. Where the standard ratings and settings do not correspond with this computation, the next higher standard rating or setting should be selected.

Heater Circuits

The water heater's electrical components are pictured and identified on page 2. The model and rating plate illustration on page 5 identifies the heater electrical characteristics. Basically, the heater has two electrical circuits:

- The control circuit, where the temperature control directly or indirectly operates the contactor coils.
- The power circuit, which is operated by the control circuit, carries the electrical load of the heating elements.

The following describes the heater circuits and includes wiring diagrams. All heater circuits are designed for 60 Hertz alternating current.

Control Circuit

The heater is equipped with one of the following control circuits, resulting in:

- Simultaneous element operation ... where all of the heating elements are switched on and off together.
- Step controlled element operation ... where elements are staged on and off individually or in groups.
- Additional instructional literature is provided with heaters equipped with modulating solid state step control. Also see page 12 in this manual for thermistor information. Heaters with thermostat step control are adjusted as described in the OPERATION section of this manual.

All control circuits are operated on single-phase 120 volt current.

CONTROL CIRCUIT FUSE TABLE

Heater Voltage	Phase	Buss (Fuse No.)	Amps	Qty.	Application
208	1	SC-15	15	1	Transformer Secondary Transformer Primary Transformer Secondary Transformer Primary
208	3	SC-15	15	1	
240	1	SC-15	15	1	
240	3	SC-15	15	2	
480 & 600	3	JJS-15	15	1	
				2	

Control circuit wiring is 14 Awg, AWM (Appliance wiring material) type, rated 600 volts, 105°C.

Standard equipment includes control circuit fusing as listed in the table.

Power Circuit

The heater is equipped with one of the power circuit configurations shown in the table.

Power circuit wiring is type THHN rated 600 volts, 105°C, sized as necessary.

Standard equipment includes power circuit fusing as listed in the table.

POWER CIRCUIT FUSE TABLE

Heater Voltage	Phase	Type	Buss Fuses No.	Amps	Qty. Per Contactor
208	1		SC-30 SC-60	30 60	4
240	1		SC-30 SC-60	30 60	4
208 & 240	3	Delta	SC-30 SC-60	30 60	3
480	3	Wye	SC-30 SC-60	30 60	3
600	3	Delta	JJS-60	60	3

ELECTRICAL CONFIGURATION TABLE

Heater Nameplate Markings		Type of Service	Voltage Between Heater Terminal Lugs †	Control Circuit Voltage (1 Phase)	Elements	
Voltage	Phase				Quantity Per Contactor	Element Operating Voltage
208	1			120	1	208
	3	Delta (With Neutral)		120	1	208
240	1			120 (Transf.)	1	240
	3	Delta		120 (Transf.)	1	240
480	3	Wye*		120 (Transf.)	1 or 2	277
600	3	Delta		120	1 or 2	600

* Neutral lug not necessary and not furnished due to three wire wye connection. This means only three wires (no neutral) brought to heater due to method of element connection. Elements operate at 277 volts.

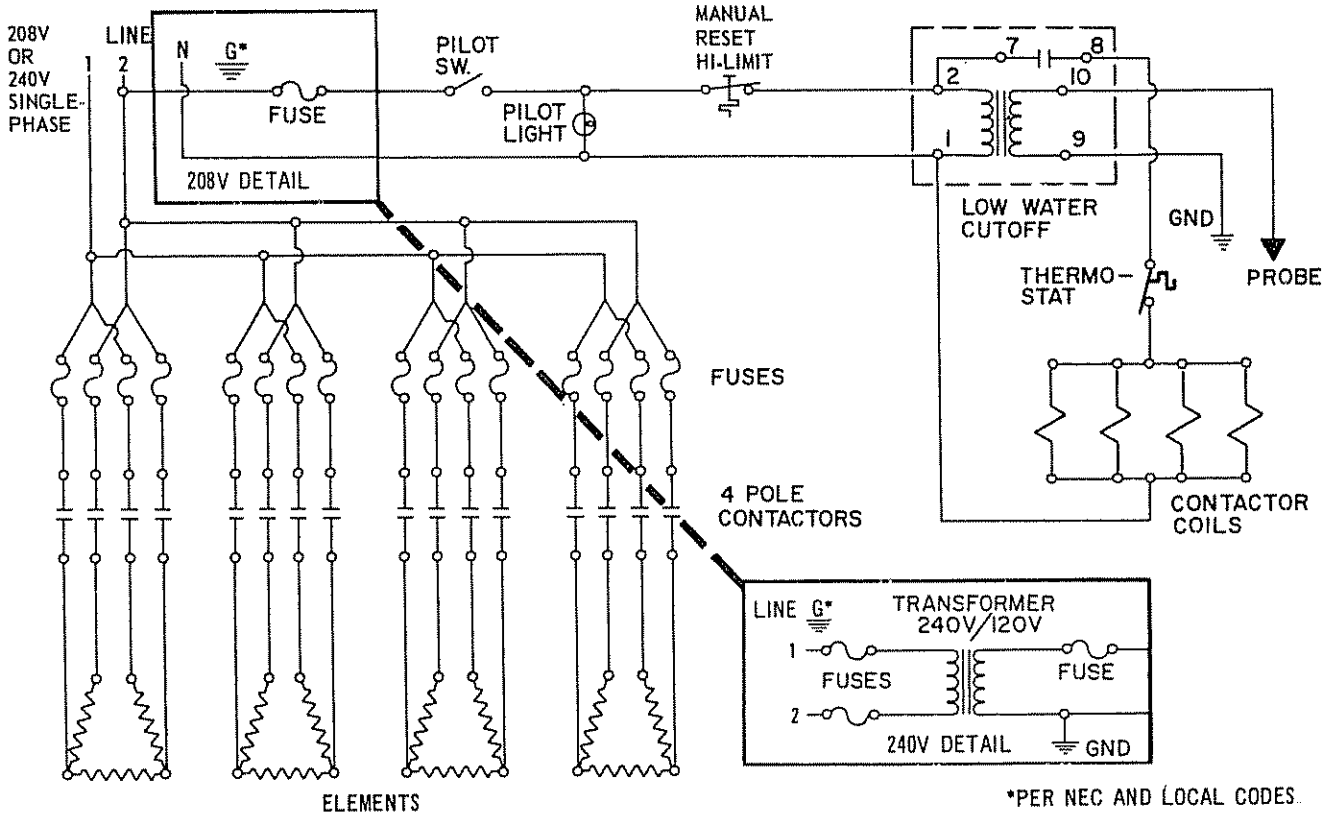
† Voltage from a conductor to ground (electrical raceway and water pipes) is not measured

• No ground lug furnished. If required installer can provide locally

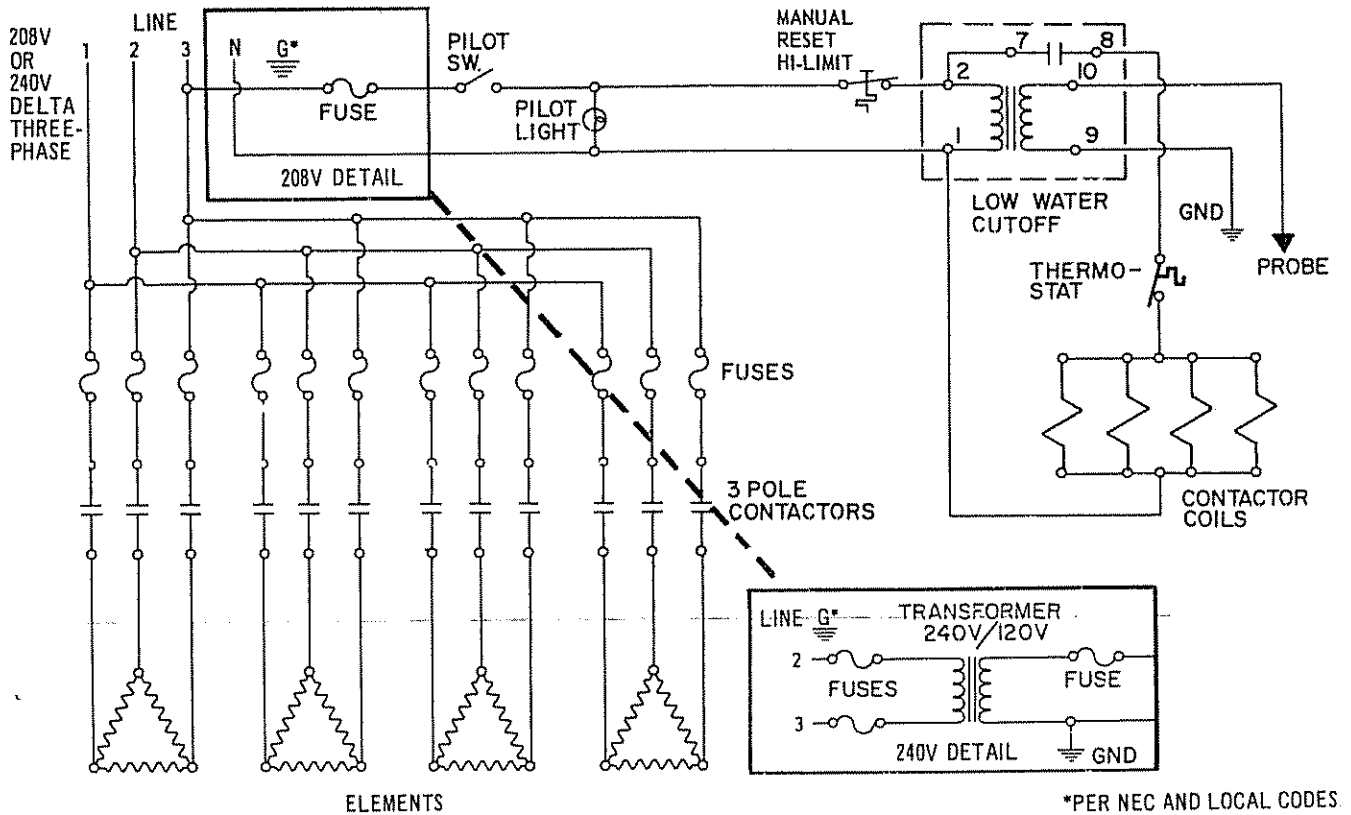
WIRING DIAGRAMS

The following wiring diagrams are included in this manual to show typical arrangements of electrical components in the control and power circuits by voltage and phase characteristics. They are to be used as a reference by the installer or servicer in performing their work. An actual diagram of the water heater wiring is furnished with the heater.

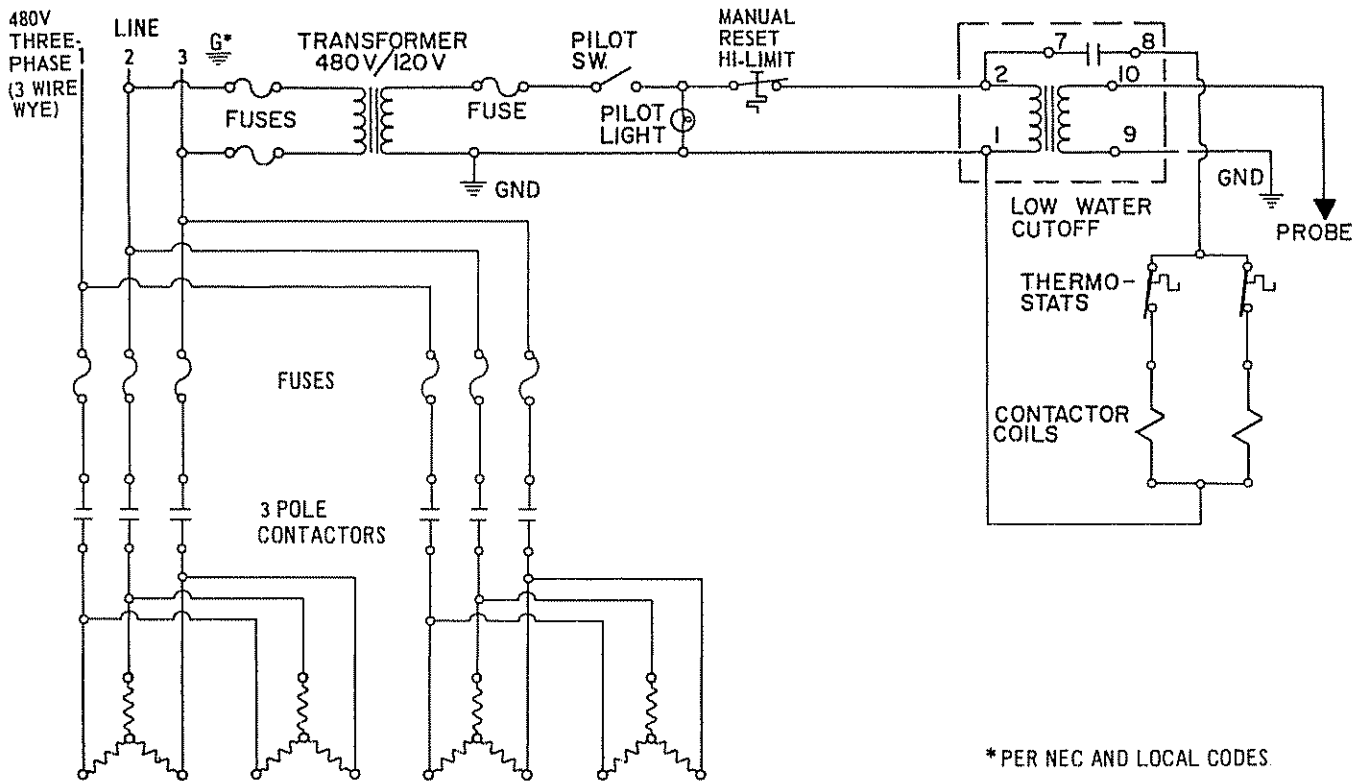
They are to be used as a reference by the installer or servicer in performing their work. An actual diagram of the water heater wiring is furnished with the heater.



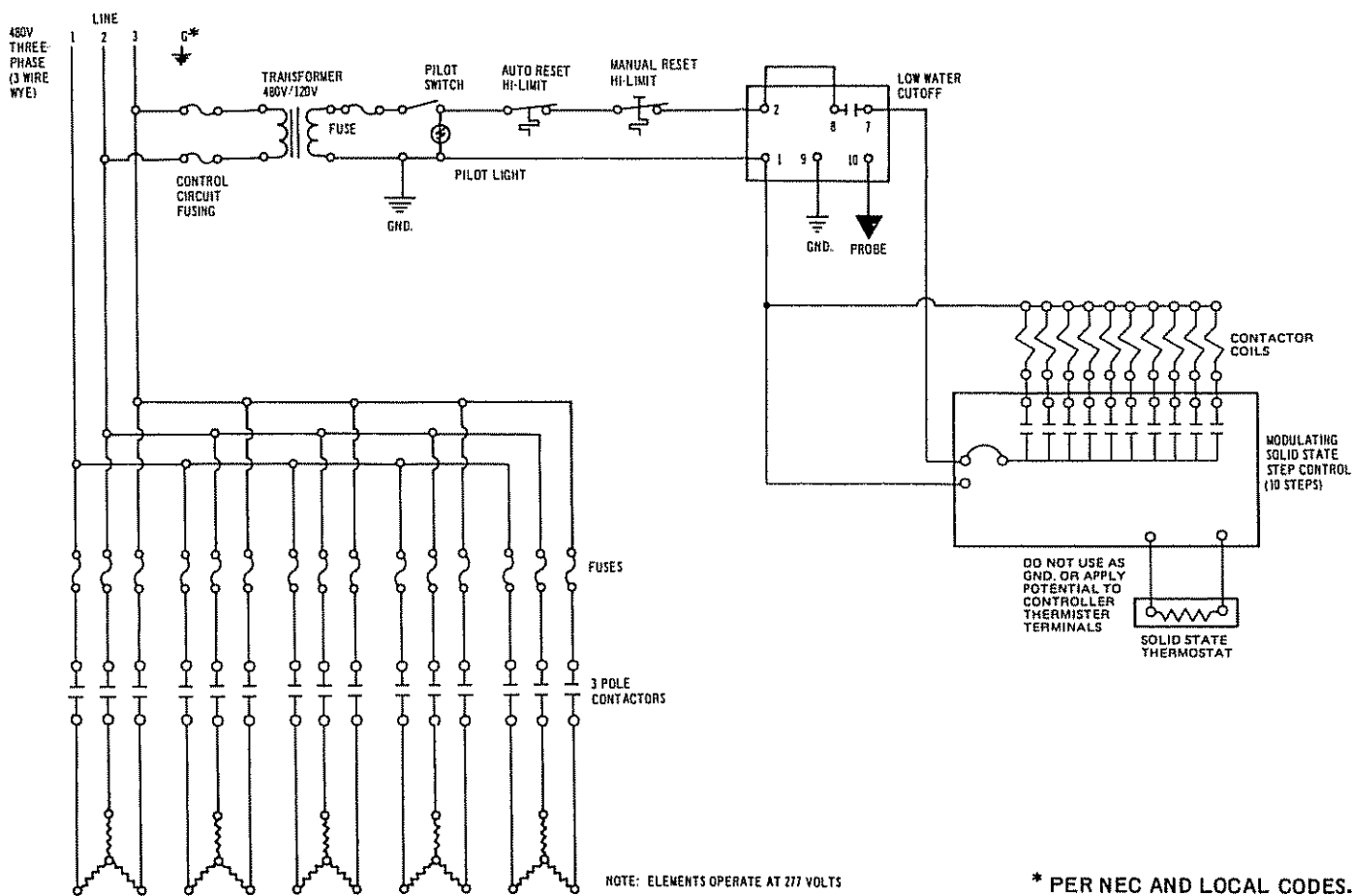
WIRING DIAGRAM - 208V OR 240V SINGLE-PHASE



WIRING DIAGRAM - 208V THREE-PHASE (DELTA, WITH NEUTRAL) OR 240V THREE-PHASE (DELTA)



WIRING DIAGRAM - 480V THREE-PHASE (3 WIRE WYE)



WIRING DIAGRAM - MODULATING SOLID STATE STEP CONTROL (10 STEP)

Thermistor

Thermistor resistance is presented here as an aid to diagnosing water temperature problems.

THERMISTOR RESISTANCE TABLE	
Tank Water Temp. °F	Ohms $\pm 20\%$
50	3.700
100	1.200
150	500
200	200
Open Sensor \square	Infinity
Shorted Sensor \blacksquare	100 to 0
Grounded Sensor \blacktriangle	Less than infinity \blacktriangle

- With ohmmeter applied to leads of thermistor (disconnected from control) and water temperature as indicated. Do not apply current other than ohmmeter power to leads when disconnected.
- ▲ Check with one ohmmeter lead to ground (bare metal) and other ohmmeter lead applied to one thermistor lead. A reading of infinity indicates thermistor is not grounded. Replace thermistor if grounded.
- PS series control will operate when OPEN and be off when SHORTED. Replace thermistor if open or shorted.

OPERATION

GENERAL

Never operate the heating elements without being certain the water heater is filled with water, and a temperature and pressure relief valve is installed in the relief valve opening on top the heater.

An electric type low water cutoff is provided on all heaters as standard equipment. The water probe is installed near the top of the tank to monitor the presence of water. The control circuit is opened if the water level is below this point.

The pilot switch on the cabinet front permits the heater to be turned on and off without having to operate the electrical disconnect switch.

- DANGER - Full power is present whenever the cabinet door is opened even with the pilot switch turned off.

Optional manual override switches on the cabinet front allow elements to be manually de-energized if full capacity is not needed.

FILLING

1. Turn off the electrical disconnect switch.
2. Close the heater drain valve.
3. Open a nearby hot water faucet to allow the air in the system to escape.

4. Fully open the cold water inlet valve, filling the heater and piping.
5. Close the hot water faucet as water starts to flow from the opening. Leave the cold water inlet valve fully open. The heater is now ready for START UP and TEMPERATURE REGULATION if being placed in operation for the first time.
6. Be sure to close the cabinet door before turning on the electricity.

START UP

The following checks should be made by the installer when the heater is placed into operation for the first time:

1. Unlock and open the cabinet door and remove front and right side panels. Check all factory and field made water and electrical connections for tightness. Also check connections on top the heater.
 - Repair water leaks and tighten electrical connections as necessary.
2. Turn on the electrical disconnect switch and pilot switch mounted on the cabinet front.

3. Observe the operation of the electrical components during the first heating cycle. Use care as the electrical circuits are energized.
 - Temperature control and contactor operation should be checked by allowing the heater to come up to temperature and shut off automatically.

TEMPERATURE REGULATION

Always turn off the electricity at the electrical disconnect switch when making a temperature control adjustment.

- DANGER - Full power is present whenever the cabinet door is opened even with the pilot switch turned off.

It is suggested the temperature control be turned to the lowest setting which satisfies the hot water requirements of the system. This helps minimize water scale formations on the heating elements. See thermostat or step control below.

Always close and lock the cabinet door after making a temperature adjustment. Turn on electricity.

Thermostat Temperature Control

When the water heater tank circulating pump accessory is specified, the thermostats of horizontal and vertical model heaters may be set to 185° F if dishwasher rinse water is supplied by the heater.

Without the circulating pump, horizontal model heaters should be set not higher than 165° F. Vertical models may be set as desired, not to exceed 185° F.

MAINTENANCE

Once a month the temperature pressure relief valve should be checked to insure that it is in operating condition. Lift the lever at the top of the valve several times until the valve seats properly and operates freely.

CAUTION: The water passing out of the valve during this checking operation may be extremely hot.

Water heater maintenance includes periodic tank flushing and cleaning, and removal of lime scale from the heating elements. Where used, water heating system circulating pumps should be oiled.

Tank flushing and circulating pump lubrication should be performed in accordance with the above schedule. Tank sediment removal and element lime scale removal must be performed when needed as determined by periodic inspections.

Where multiple thermostats are used on a vertical model heater, they may all be set at the same temperature or 2° to 4° F apart to achieve "step control". The bottom thermostat is set the hottest and the top thermostat the coolest.

Modulating Solid State Step Control

Additional instructional literature is provided with the heater for adjusting this control. Altho the control may have a maximum setting of 240° F, the setting for water heating systems should not exceed 185° F and then only if dishwasher rinse water is supplied by the heater.

DRAINING

The water heater must be drained if it is to be shut down and exposed to freezing temperatures. Maintenance and service procedures may also require draining the heater.

1. Turn off the electrical disconnect switch.
2. Close the cold water inlet valve to heater.
3. Open a nearby hot water faucet to vent the system.
4. Open drain valve.
5. If the heater is being drained for an extended shutdown, it is suggested the drain valve be left open during this period.
 - Follow FILLING instructions when restoring hot water service.

MAINTENANCE SCHEDULE

Component	Operation	Interval	Required
Tank	Flushing	Monthly	
	Sediment Removal	As Needed	
Elements	Lime Scale Removal	As Needed	UNOLIME® Delimer and element gaskets.
Circulating Pump	Oiling	Four Months	SAE No. 20 non-detergent motor oil.

Following are the instructions for performing recommended maintenance.

FLUSHING

1. Turn off the electrical disconnect switch.
2. Open the drain valve. Allow water to flow

until it runs clean.

3. Close the drain valve when finished flushing.
4. Turn on the electrical disconnect switch.

SEDIMENT REMOVAL

Water borne impurities consist of fine particles of soil and sand which settle out and form a layer of sediment on the bottom of the tank. In time, if not removed, the level of sediment might reach the heating elements.

For convenience, sediment removal and element lime scale removal should be performed at the same as follows:

WATER AND LIME SCALE REMOVAL

Water and lime scale accumulations on the heating elements is a normal condition, common to all immersion type elements. Factors which affect the amount of this formation are:

1. Amount of hot water used. As the volume of water heated increases, more scale results.
2. Water temperature. As the temperature of the water is increased, more scale is deposited on the elements.
3. Characteristics of water supply. Regardless of water treatment, the elements should be examined regularly.

Water scale accumulations may cause noises to occur during operation.

It is recommended that a lower heating element be removed periodically for examination. If it is scaled, all of the elements should be removed and cleaned. If the tank bottom has an accumulation of sediment, it should be cleaned.

Lime scale should be removed by dissolving the accumulation in UNOLIME® delimer. UNOLIME is a non-muriatic delimer, available through water heater distributors. Do not use muriatic or hydrochloric acid base deliming solutions to remove lime scale from the elements. All models: Do not pour delimer into tank.

DANGER: Keep all delimers away from anode rods to prevent the formation of flammable and explosive gas. Vertical model heaters have anodes in the bottom of the tank.

1. Turn off electrical disconnect switch.
2. Drain the heater following DRAINING instructions.
3. Disconnect the wires attached to the element terminals. Try not to disturb the wir-

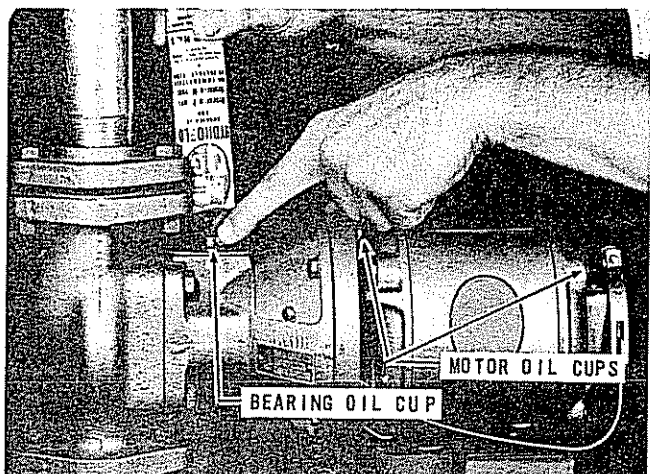
ing unnecessarily and reconnection will be easier.

4. Remove the bolts from each element and remove the elements from the openings.
 - Use a twisting, pulling action to remove elements scaled beyond the size of the tank openings.
 - Brush loose scale from elements.
 - Silicates, sulfates and aluminates must be removed by scraping or other mechanical means. Lime scale dissolvents will not remove these types of scale which are occasionally encountered.
5. Lime scale removal:
 - Place limed ends of heating elements into UNOLIME delimer and allow scale to dissolve. Do not permit delimer or water to contact heating element electrical terminals.
6. Flush cleaned ends of elements with water when deliming or cleaning is completed.
7. Remove sediment and scale from the tank bottom through the access provided by the element opening or tank cleanout, if furnished.
 - The cold water inlet valve and drain valve may be opened to aid the cleanout process.
8. Clean remaining gasket material from tank and element flanges. Do not reuse original element gasket. The element gasket is Part No. 5109.
9. Replace elements as follows:
 - Put a new gasket on each element.
 - Install into tank opening from which element was removed.
 - Uniformly tighten element bolts. Torque to approximately 32 ft/lbs.
10. Attach wires to element terminals from which they were removed.
11. Follow FILLING instructions to restore hot water service.
 - Check for water leaks around elements and proper operation when heater is filled.

CIRCULATING PUMP

The water heater or water heating system may include a circulating pump. Where used, it should be lubricated once every four months with SAE No. 20 non-detergent motor oil or as directed by the manufacturer.

- Place 2 to 3 teaspoonsful in the bearing oil cup and 10 to 12 drops in the motor oil cups.



CHECKLIST

Before calling for service, check the following points to see if the cause of trouble can be identified and corrected. Reviewing this checklist may eliminate the need of a service call and quickly restore hot water service. The illustration on page 2 identifies the location of most of the heater components.

BE SURE TO TURN OFF THE ELECTRICITY WHEN CHECKING EQUIPMENT.

Not enough or no hot water

1. Be certain the electrical disconnect switch serving the water heater is in the ON position. The pilot switch on the cabinet front should be ON.
 - In some areas water heater electrical service may be limited by the power company. If the heater operates on a controlled circuit, heater recovery may be affected.
 - The optional manual override switches on the cabinet front may be turned off, de-energizing elements.
2. Check the fuses.
 - The electrical disconnect switch usually contains fuses.
 - The water heater has fuses located behind the cabinet front door, see pages 2, 9 and 12 for location and data.
3. If the water was excessively hot, and is now cold, the high temperature cutoff may have operated (manual reset equipped models).
 - To reset, turn off electricity and remove the right side panel of the water heater and push the reset button.

- Repeated operation of the high temperature cutoff should be investigated by your dealer.

4. The capacity of the heater may have been exceeded by a large demand for hot water.
 - Large demands require a recovery period to restore water temperature.
5. Cold incoming water temperature will lengthen the time required to heat water to the desired temperature.
 - If the heater was installed when incoming water temperature was warm, colder water creates the effect of less hot water.
6. Look for hot water wastage and leaking or open hot water faucets.
7. Sediment or lime scale may be affecting water heater operation. Refer to MAINTENANCE for details.

Water is too hot

1. Refer to TEMPERATURE REGULATION.

Water heater makes sounds

1. Sediment or lime scale accumulations on the elements causes sizzling and hissing noises when the heater is operating.
 - The sounds are normal, however, the tank bottom and elements should be cleaned. Refer to MAINTENANCE for details.
2. Some of the electrical components of the water heater make sounds which are normal.
 - Contactors will "click" or snap as the heater starts and stops.
 - Transformers and contactors often hum.

Water leakage is suspected

1. Check to see if the drain valve is tightly closed.
2. The apparent leakage may be condensation which forms on cool surfaces of the heater and piping.
3. If the outlet of the relief valve is leaking it may represent:
 - Excessive water pressure.
 - Excessive water temperature.
 - Faulty relief valve.

Excessive water pressure is the most common cause of relief valve leakage. It is often caused by a "closed system". A check valve in the inlet system will not permit the expanded hot water volume to equalize pressure with the main. A relief valve must release this water or the water heater or plumbing system will be damaged.

When such a condition is encountered, local codes or inspection agency should be consulted to determine which system is acceptable in your area. These may consist of:

- Installation of a second relief valve with lower setting than the primary relief valve.
- An expansion tank of suitable pressure and provision to avoid water logging.
- Removal of the check valve.

4. Examine the flange area of the elements for gasket leakage.
 - Tighten the bolts or, if necessary, follow the WATER AND LIME SCALE REMOVAL procedure to replace the gaskets.

IF YOU CANNOT IDENTIFY OR CORRECT THE SOURCE OF MALFUNCTION:

1. Place the water heater electrical disconnect switch in the OFF position.
2. Close the cold water inlet valve to the heater.
3. Contact your dealer.