



BROWARD COUNTY BOARD OF RULES AND APPEALS

1 N. University Drive, Suite 3500B
Plantation, FL 33324

Phone: 954-765-4500
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broward.org/CodeAppeals

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—ESTABLISHED 1971—

To: Members of the Plumbing Technical Advisory Committee

James Terry Daniel Rourke Gregg D'Attile Cary Bauer Mike Lange
Alan Corriveau Pablo Camacho Carl Rasmussen Richard Bong Gary Kozaan
Albert Korelishn Sandra Lluís

From: Otto Vinas, Chief Plumbing Code Compliance Officer

Date: July 18, 2019

Subj: Plumbing TAC Committee to discuss "Replacement of water heaters" and "discussion of storm drain pipe sizing conversion from gallons per min to square footage.

The Chairman of the Plumbing TAC Committee, Mr. Terry, has called for a meeting on Wednesday August 14, 2019 from 10:00AM to 1:00 PM at the Deicke Auditorium Room#63377 5701 Cypress Road, Plantation, FL 33317. The latest issues concerning water heaters requirements, will be discussed.

Agenda

1. Roll Call
2. Welcome of New Committee Members: Mr. Richard Bong
Mr. Albert Korelishn
3. Acceptance of October 22, 2013 meeting minutes

Regular Meeting

Item 1: Discussion of replacement of water heaters

- 1a. Staff summary on codes changes regarding water heaters · p.5
- 1b. Miami-Dade County permit exemptions on electric water heaters · p.7
- 1c. BOAF informal interpretations concerning water heaters · p.9
- 1d. Florida Building Commission Dec Statement on water heaters installed in garage (pans) · p.12
- 1e. ICC communications form Gary Nelson concerning relief lines · p.18
- 1f. Building departments addendum forms · p.23
- 1g. FBC, Existing Section 609 Plumbing and Section 607 Electrical · p.26
- 1h. Rheem electric water heater manual · p.28
- 1i. A.O. Smith electric water heater manual · p.48
- 1j. Fire Arson article from Mark Goodson concerning water heater fires in 2000 · p.68

Item 2: Discussion of storm drain pipe sizing conversion chart from gallons per minute to square footage from Kamm Consulting

- 2a. FBC-Plumbing, 6th Edition (2017) Chapter 11 Storm Drainage · p.73
- 2b. Kamm Consulting conversion chart from gallons per minute to square footage · p.83
- 2c. Broward County Administrative Provisions Chapter One Section 1074.32 Alternative · p.86 materials, design and methods of construction and equipment
- 2d. Typical roof drain from ZURN and SMITH · p.87

General Discussion.

Adjournment.



BROWARD COUNTY

Board of Rules & Appeals

One North University Drive, Suite 3500-B, Plantation, Florida 33324

Phone (954) 765-4500 Fax: (954) 765-4504

<http://www.broward.org/codeappeals.htm>

**Board of Rules and Appeals
Plumbing Technical Advisory Committee
October 22, 2013
Meeting Minutes**

CALL TO ORDER

A published meeting of the Board of Rules and Appeals Plumbing Technical Advisory Committee was called to order by Chair, Mr. Richard Smith, at 2:09 p.m., at the Emergency Management Division, Emergency Operations Center, Room 329, 201 NW 84th Avenue, Plantation, Florida 33324.

ROLL CALL

Present

Richard Smith, Chair
Albert Korelishn
Cary Bauer
James Bickford
Alan Corriveau
Gregg D'Attile
Joseph DeMaio
John Dodd
Gary Hildebrandt
Gary Kozan
Sandra Lluis
Kenneth Wynn

Excused

Dennis Pustizzi

Chief Plumbing Code Compliance Officer, Otto Viñas

After roll call, the presence of a Quorum was announced by Chair Richard Smith, who then welcomed Alan Corriveau as a newly appointed member to the committee.

APPROVAL OF MINUTES: Meeting of October 10, 2012

Cary Bauer MOVED and proposed the MOTION to approve the October 10, 2012, Plumbing Committee meeting minutes. Gregg D'Attile SECONDED the motion. The MOTION carried UNANIMOUSLY.

Item I 2010 FBC Plumbing

MOTION: Gary Kozan made a MOTION to first change the tables in both the Plumbing Code and the Residential Code, the Plumbing Code table is 604.4 and the Residential Code table is 2903.2, to read the flow rate for lavatory faucet would be 1.5, the shower heads would be 2.0, and the kitchen faucets would be 2.2. The rest of the table and the exception allowing for all fixture fittings and appliances US environmental agency WaterSense label would remain the same. James Bickford SECONDED the MOTION. The MOTION carried UNANIMOUSLY.

It was requested that Staff provide updated tables to committee members.

Item II Sway Bracing

MOTION: Gary Kozan made a MOTION to interpret 308.6 Sway Bracing to include drainage piping only and 308.7, regarding axial movements, to pertain only to drainage piping four (4) inches and greater using mechanical couplings with elastomeric seals. James Bickford SECONDED the MOTION. The MOTION carried by a showing of hands vote with six members in favor and five members opposed.

Item III 2" Washing Machine

MOTION: James Bickford made a MOTION that this committee agrees with the interpretation by the Building Officials Association of Florida, reports #6501 (2007 Residential Code) and #4939 (2004 Residential Code), stating that a two (2) inch stack is sufficient on laundry in buildings regulated by the Florida Residential Code. Gary Kozen SECONDED the MOTION. The MOTION carried unanimously.

Item IV Wet Dumpster Drains

Committee members agreed that the code is clear on the issue.

General Discussion

Gregg D'Attile described a concern regarding water heater change-outs. After discussion, Mr. Smith proposed the issue be included as an agenda item of the committee's next meeting.

Mr. Bickford mentioned an American Society of Sanitary Engineers (ASSE) meeting, where Bob Carpenter from IAPMO spoke. Mr. Carpenter's presentation concerned lead content in brass fittings. A Federal change to the Safe Drinking Water Act will make it illegal to sell or to install anything with more than .25% lead in the brass after January 4, 2014.

Mr. Viñas and Mr. DeMaio brought up a concern with ASTM Designation F2536-06b, providing a handout. Discussion ensued regarding enforcement.

Adjournment

MOTION: Mr. Korelishn made a MOTION to adjourn the meeting. Mr. Bauer SECONDED the MOTION. As the MOTION passed UNANIMOUSLY, the meeting adjourned at 3:50 P.M..

Item 1

Discussion of replacement of water heaters

To: Members of the Plumbing Advisory Committee
From: Otto Vinas, Chief Plumbing Code Compliance Officer
Date: June 20, 2019
Re: Water heaters

RECOMMENDATION

It was recommended by the Plumbing Advisory Committee for staff to provide a history report on water heater code changes to Broward County municipalities for inspection purposes.

Summary:

The South Florida Building Code became effective on 6-1-1972.

On 2-28-1975 the code amended the following; the valve discharge outlet pipe shall not be smaller than the valve to which is connected. The outlet pipe shall not be trapped and shall be installed to drain dry.

Water heater pans required since 8-1-1979.

The code was amended on 9-1-1992 deleting the use of 3/8" relief line.

The Florida Building Code was adopted on 3-1-2002.

The **Residential Code** was adopted in 2004.

2007 code added piping for safety pan drains shall be of those materials listed in Table 605.4 and Table P2904.5

3 changes in the 2010 code. One discusses M1305, fuel oil systems installations. Second discusses P2803.7 vacuum relief valve for bottom fed heaters. Third changed P2803.6.1 requirements for discharge pipe to floors and water heater pans.

3 changes in the 5th Edition. P2801.6 an exception for water heaters installed in garages for listed flammable vapor ignition-resistant. Section 504.4.1 ANSI requirements on temperature and pressure relief valves. A thermostat control for a water heater shall not serve as the temperature limiting means for fixtures.

4 changes in the 6th Edition. P2801.6.1 where a drain pan was not previously installed, a pan drain shall not be required for a replacement water heater. P2802 all new section concerning solar water heater systems water temperature control and isolation valves. P2804.6.1 the discharge pipe serving a relief line shall not terminate less than 2 times the discharge pipe

diameter above the floor or waste receptor. P2804.6.1.14 when using PEX or PE-RT for relief line must be one nominal size larger.

Additional Information:

BOAF 4077 Informal Interpretation on 12/5/2005 stating that a relief line may discharge directly to the floor.

BOAF 4544 Informal Interpretation on 7/26/2006 on requirements water heater drain pans in garages.

BOAF 6136 Informal Interpretation on permit requirements to replace a water heater.

Florida Building Commission Declaratory Statement DS 2014-084 on drain pan requirements dated 11/20/2014.

Communication from Gary Nelson (ICC), 2-8-2014, statement prohibiting the relief line to discharge to the floor if damage can be caused to drywall, wood framing, insulation, finish and trim, flooring, etc.

Reasons

The history report will provide guidance to Broward County Plumbing Inspectors. Based upon practical experience of the Plumbing Advisory Committee members, it was felt the history report will provide uniformity.

Respectfully submitted,



Otto Vinas

1 b.

III. Exemptions for Work in Single-family Residences, Duplexes, Townhouses and Condominiums

The following permit exemptions for single-family residences, duplexes, townhouses and condominiums have been established for unincorporated Miami-Dade County based upon Section 102.2.5 of the Florida Building Code. The total cost in the aggregate of all the below noted work performed by owner-builders or contractors in any 12-month period cannot exceed \$5,000.00. The permit exemptions are as follows:

A. Mechanical

- Replacement of window air conditioning unit.
- Installation of ductless range hoods.

B. Building

- Installation or repair of canvas or cloth covered awnings.
- Installation or repair of rain gutters.
- Enclosure of existing covered patios/balconies/porches with screening.
- Installation of chain-link fences other than those intended to satisfy swimming pool barrier requirements (Requires [Zoning Improvement Permit \(http://www.miamidade.gov/permits/zoning-improvement.asp\)](http://www.miamidade.gov/permits/zoning-improvement.asp)).
- Concrete slabs outside of the building (other than screened patios and pool slabs); items such as, but not limited to, open patios, walkways or garbage containers.

C. Electrical

- Repair work performed by licensed electrical contractors that does not exceed \$500.00 in value of materials and labor.
- The following work is also exempt from permit requirements regardless of the value of materials and labor:
 - Repair or replacement of electrical wall switches and wall outlet devices (receptacles) 20 amps and 120 volts or less.
- Low-voltage electrical systems in single-family residences, duplexes and townhouses (excludes condos).

IV. Exemptions for Minor Repairs on Residential and Commercial Properties

The following permit exemptions for minor repairs have been established for unincorporated Miami-Dade County under Section 105.2.2 of the Florida Building Code:

A. Electrical

- Repair or replacement of electric water heaters 4500 watts or less. If the wattage of the new water heater to be installed is greater than the wattage of the water heater to be replaced, then a permit is required for this work.
- Change out of air conditioning equipment provided it is of the same electrical, cooling/heating and capacity/ampereage.
- Repair or replacement of the following low voltage (under 98 volts) devices:
 - Telephone
 - Television
 - Data Cable
 - Central Vacuum
 - Burglar Alarm
 - Intercom System
- Repair or replacement of electric wiring to pumps less than 1 h.p.
- Repair or replacement of time clocks.

B. Plumbing

- Repair work performed by licensed plumbing contractors that does not exceed \$500.00 in value of materials and labor.
- The following work is also exempt from permit requirements regardless of the value of materials and labor when performed by a licensed plumbing contractor:
 - Repair or replacement of gas appliances, other than water heater, by licensed plumbing contractors.
 - Change out of an above-ground LP tank.
 - Repair irrigation system.
 - Repair domestic water service/lines.
 - Repair to building sewer line, excluding repair or replacement of interceptors/separators, by licensed plumbing contractors.
 - Repair/replacement of faucets.
 - Repair/replacement of water closet/bidet/urinal fixtures only.
 - Repair/replacement of sink/lavatory/drinking fountain fixtures only.
 - Repair/replacement of residential pool equipment other than a pool heater.
 - Repair/replacement of shut-off valve on a domestic water line.
 - Capping of waste line leading to septic tank.
 - Repair/replacement of residential disposal.
 - Repair/replacement of residential dishwasher.
 - Repair/replacement of electric water heater up to 50-gallon capacity by licensed plumbing contractors.

C. Mechanical

- Repair work performed by licensed mechanical contractors that does not exceed \$500 in value of materials and labor.
- The following work is also exempt from permit requirements regardless of the value of materials and labor when performed by a licensed mechanical contractor:
 - Repair of air conditioning duct.
 - Repair or replacement of coil, compressor or refrigerant piping by licensed air conditioning or mechanical contractor.
 - Repair or replacement of non-combustion heating by licensed air conditioning or mechanical contractors.
 - Repair of ventilation fans.

D. Building

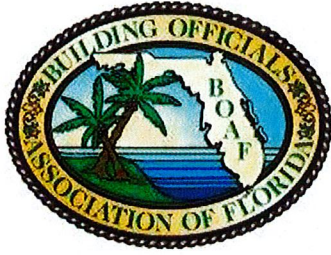
- Repair work performed by licensed building contractors that is not structural in nature and does not change the occupancy, does not affect life safety and the value of which does not exceed \$2,000.00 in labor and materials.
- The application, construction or repair of any roof covering performed by a licensed roofing contractor not exceeding \$2,000.00 in value of materials and labor or work not exceeding two roofing squares in extent.

V. Satellite Antennas

Pursuant to federal law, a permit is not required for the installation or repair of satellite antennas that are one meter (approximately 39 inches) or less in diameter which are located on commercial or industrial properties. For residential properties, the installation or repair of satellite antennas attached to primary structures which are one meter (approximately 39 inches) or less in diameter are exempt from permit requirements. Note that permit exemption does not exclude dishes from being safely installed.

Page Last Edited: Thu Dec 27, 2018 1:21:53 PM





**Informal Interpretation Report
Number 6136**



Date 04/14/2009
Report 6136
Edition: 2007
Section 105.1

Question:

Is it the intent of Florida Building Code - Building section 105.1 to require permits for the replacement of gas or electric water heaters? Sections 105.1 and 105.2 are very specific as to required permits and what is exempt from permit. Since "water heater" is not specifically mentioned, should they be exempt?

Answer:

Yes. It is the intent of Florida Building Code - Building section 105.1 to require permits for the replacement of gas and electric water heaters. No, water heater replacements are not exempt from permit requirements.

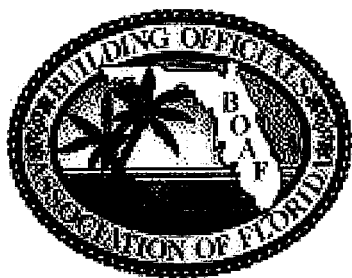
On 04/21/2009 at 8:03 PM

Commentary:

None.

Notice:

The Building Officials Association of Florida, in cooperation with the Florida Building Commission, the Florida Department of Community Affairs, ICC, and industry and professional experts offer this interpretation of the Florida Building Code in the interest of consistency in their application statewide. This interpretation is informal, non-binding and subject to acceptance and approval by the local building official.



Florida Building Code Informal Interpretation



Date: Mon Dec 5 2005

Report #: 4077

Code: Plumbing

Section: 504.6.1

Question:

(1) Is it the intent of 504.6.1 to allow the relief line to terminate within 6" of the floor in the living space of an existing building? (2) When an existing relief line extending to the outside is present can it be used without a visible air gap located inside the same room as the water heater?

Answer:

(1) Yes it is the intent of 504.6.1 to allow the relief line to terminate within 6" of the floor in the living space of an existing building as long as it will not cause structural damage to the building or personal injury to the occupants. (2) No, there is no exception to the requirement for a visible air gap in the room with the water heater when the relief line exits the room

Commentary:

As an alternative, the FBCEB in s. 1201.2.4 provides that for alterations and repairs "An existing building or portion thereof that does not comply with the requirements of this code for new construction shall not be altered or repaired in such a manner that results in the building being less safe or sanitary than such building is currently. If, in the alteration or repair, the current level of safety or sanitation is to be reduced, the portion altered or repaired shall conform to the requirements of Chapters 2 through 36 of the Florida Building Code, Building."

Notice:

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Florida Building Code Informal Interpretation



Date: Wed Jul 26 2006

Report #: 4544

Code: Plumbing

Section: 504.7

Question:

Is it the intent of section 504.7 of the fpc not to require a pan for the heater when the heater is installed on the finish floor level of the home in the garage, not the step down section of the garage floor

Answer:

Yes.

Commentary:

A garage is not habitable space and no pan is required even if the heater is installed at the same elevation as the finished floor of the structure.

Notice:

The Building Officials Association of Florida, in cooperation with the Florida Building Commission, the Florida Department of Community Affairs, ICC, and industry and professional experts offer this interpretation of the Florida Building Code in the interest of consistency in their application statewide. This interpretation is informal, non-binding and subject to acceptance and approval by the local building official.

1 d.

FILED	
Department of Business and Professional Regulation	
Deputy Agency Clerk	
CLERK	Brandon Nichols
Date	11/20/2014
File #	2014-09024

**STATE OF FLORIDA
BUILDING COMMISSION**

In the Matter of

GARY KOZAN for
RIDGEWAY PLUMBING, INC.
Petitioner.

DS 2014-084

DECLARATORY STATEMENT

The foregoing proceeding came before the Florida Building Commission (Commission) by a Petition from Gary Kozan for Ridgeway Plumbing, Inc. (Petitioner), which was received July 3, 2014. Based on the statements in the petition, the material subsequently submitted and the subsequent request by the Petitioner, the Commission states the following:

Findings of Fact

1. The petition is filed pursuant to, and must conform to the requirements of Rule 28-105.002, Florida Administrative Code.
2. Petitioner is a plumbing contractor with an upcoming single-family project in Indian River County in which the water heaters are located in the garage but on the same floor level as the home's interior.
3. Petitioner seeks clarification of the applicability of Sections 504.7, Florida Building Code, Plumbing (2010) and 2801.5, Florida Building Code, Residential (2010) as to whether a water heater installed in a garage at the same interior floor elevation is required to have a pan.
4. Specifically, Petitioner requests answers to the following question: whether a water heater that is installed in a garage, but at the same elevation as the interior finished floor, is required to have a pan?

Conclusions of Law

5. The Commission has the specific statutory authority pursuant to Section 553.775(3)(a), Florida Statutes (2014) to interpret the provisions of the Florida Building Code by entering a declaratory statement.

6. Section 504.7, Florida Building Code, Plumbing (2010) states:

Where water heaters or hot water storage tanks are installed above the ground floor space, in attics or ceiling areas, or within the habitable space, the tank or water heater shall be installed in a galvanized steel or other metal pan of equal corrosion resistance having a minimum thickness of not less than 0.0236 inch (0.6010 mm) (No. 24 gage), or other pans approved for such use. Electric water heaters shall be installed in a metal pan as herein required or in a high-impact plastic pan of at least 0.0625 inch (1.59 mm) thickness.

7. Section 2801.5, Florida Building Code, Residential (2010), states:

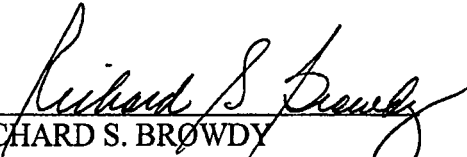
Where water heaters or hot water storage tanks are installed above the ground floor space, or in attics or ceiling areas, or within the habitable space, the tank or water heater shall be installed in a galvanized steel or other metal pan of equal corrosion resistance having a minimum thickness of not less than 0.0236 inch (0.6010 mm) (No. 24 gage) or other pans approved for such use. Listed pans shall comply with CSA LC3. Electric water heaters shall be installed in a metal pan as herein required or in a high-impact plastic pan of at least 0.0625 inch (1.59 mm) thickness.

8. Section 202, DEFINITIONS, Florida Building Code, Building states:

HABITABLE SPACE. A space in a structure for living, sleeping, eating or cooking. Bathrooms, toilet compartments, closets, halls, screen enclosures, sunroom Categories I, II and III as defined in the AAMA/NPEA/NSA 2100, storage or utility space and similar areas are not considered habitable space.

9. In response to Petitioner's request, the answer is no. As per Chapter 2, "Definition of Habitable Space," a garage is not habitable space and no pan is required even if the heater is installed at the same elevation as the finished floor of the structure.

DONE AND ORDERED this 18th day of November, 2014 in Jacksonville,
Duval County, State of Florida.


RICHARD S. BROWDY
Chairman, Florida Building Commission

NOTICE OF RIGHT TO APPEAL

Petitioner and all other interested parties are hereby advised of their right to seek judicial review of this Order in accordance with Section 120.68(2)(a), Florida Statutes (2014), and Florida Rules of Appellate Procedure 9.110(a) and 9.030(b)(1)(C). To initiate an appeal, a Notice of Appeal must be filed with Agency Clerk, Department of Business and Professional Regulation, 1940 North Monroe Street, Tallahassee, Florida 32399-1000 and with the appropriate District Court of Appeal not later than thirty (30) days after this Order is filed with the Clerk of the Department of Business and Professional Regulation. A Notice of Appeal filed with the District Court of Appeal shall be accompanied by the filing fee specified by Section 35.22(3), Florida Statutes (2014).

CERTIFICATE OF FILING AND SERVICE

I HEREBY CERTIFY that a true and correct copy of the foregoing order has been filed with the undersigned and furnished by U. S. Mail to the persons listed below this 20th day of November, 2014.



Agency Clerk's Office
Department of Business and Professional Regulation
& Florida Building Commission
1940 North Monroe Street
Tallahassee, Florida 32399-1000

Via U.S. Mail

Attn: Gary Kozan
Ridgeway Plumbing, Inc.
640 Industrial Avenue
Boynton Beach, Florida 33426-3694

Via Inter-Office or Email Delivery

Mo Madani, Planning Manager
Codes and Standards Section
Department of Business and Professional
Regulation
1940 North Monroe Street
Tallahassee, Florida 32399
Mo.Madani@myfloridalicense.com

Marjorie Holladay
Joint Administrative Procedures Committee
Pepper Building, Room 680
Tallahassee, Florida 32399-1300



BUILDING STRONG CO

FILED	
Department of Business and Professional Regulation Deputy Agency Clerk	
CLERK	Brandon Nichols
Date	7/3/2014
File #	

July 3, 2014

Florida Building Commission
1940 North Monroe Street
Tallahassee, FL 32399
ATTN: Mo Madani

DS 2014-084

RE: Petition for Declaratory Statement before the Florida Building Commission

Dear Mr. Madani:

I am a plumbing contractor involved in numerous tract residential projects statewide. I have an upcoming single-family project in Indian River County in which the water heaters are located in the garage, but on the same floor level as the interior of the house. I am requesting an interpretation of Section 504.7, Florida Building Code, Plumbing 2010, and its corresponding Section 2801.5 Florida Building Code, Residential 2010.

Both Section 504.7 FBC-P and 2801.5 FBC-R read:

504.7 Required pan: Where water heaters or hot water storage tanks are installed above the ground floor space, in attics or ceiling areas, or within the habitable space, the tank or water heater shall be installed in a galvanized steel or other metal pan of equal corrosion resistance having a minimum thickness of not less than 0.0236 inch (0.6010 mm) (No. 24 gage), or other pans approved for such use.

The issue is whether a water heater that is installed in a garage, but at the same elevation as the interior finished floor, is required to have a pan. It has been my past experience in all of the dozens of AHJs in which we perform work, that the answer is NO. The garage is not considered to be "habitable space", despite whether the garage floor is contiguous with the living space. This interpretation would seem to be backed up by BOAF Informal Interpretation # 4544 (attached).

I am requesting that the Florida Building Code issue a Declaratory Statement, affirming the prior BOAF interpretations, stating that a garage is not habitable space, and that no pan is required even if the water heater is installed at the same elevation as the finished floor of the structure.

It is in the interest of statewide uniformity that I respectfully submit this request.

Sincerely,

RIDGEWAY PLUMBING, INC

Gary Kozan
COO

Ridgeway Plumbing, Inc., 640 Industrial Ave. Boynton Beach, Florida 33426-3694 | Tel. (561) 732-3176 | Fax. (561) 369-0118



Florida Building Code Informal Interpretation



Date: Wed Jul 26 2006

Report #: 4544

Code: Plumbing

Section: 504.7

Question:

Is it the intent of section 504.7 of the fpc not to require a pan for the heater when the heater is installed on the finish floor level of the home in the garage, not the step down section of the garage floor

Answer:

Yes.

Commentary:

A garage is not habitable space and no pan is required even if the heater is installed at the same elevation as the finished floor of the structure.

Notice:

The Building Officials Association of Florida, in cooperation with the Florida Building Commission, the Florida Department of Community Affairs, ICC, and industry and professional experts offer this interpretation of the Florida Building Code in the interest of consistency in their application statewide. This interpretation is informal, non-binding and subject to acceptance and approval by the local building official.

Joe DeMaio

From: Gary Nelson <gnelson@iccsafe.org>
Sent: Saturday, February 08, 2014 12:31 PM
To: Joe DeMaio
Cc: Lis Valdemarsen
Subject: Code interpretation
Attachments: 20140207162447882.tif

Importance: High

February 7, 2014

Mr. Joseph W. DeMaio
Chief Plumbing Inspector
Building Department
City of Lauderdale, FL
JDeMaio@fortlauderdale.gov

**RE: Section 504.6 of the
ICC International Plumbing Code/2009**

Mr. DeMaio:

On February 7, 2014 we received your e-mail of the same date concerning water heaters and their safety devices. Our answers to your correspondence are contained herein and are based on the above referenced code section.

We understand your situation involves a building or structure, such as a house, that contains a typical water heater. This building service component will be located in a part of the building or structure that is not habitable or occupiable but is still finished with gypsum board, trim, floor finish, etc. You are specifically asking whether the discharge piping from the pressure relief valve or temperature relief valve or combination valve can simply discharge to the floor in accordance with Item No. 5 of Section 504.6 without regards to the provisions of Item No. 6 of that same section. The answer is No.

As you have correctly noted in our recent phone conversation, the discharge piping for the pressure / temperature relief valve(s) of a water heater is an integral part of the overall safety devices required for all water heaters. Attached please find copies of Pages 5-14 through 5-16 of the ICC International Plumbing Code/2009 Commentary. As highlighted, the structural damage due to a leaking water heater or its relief valve must be minimized to not only the wood framing members but also to the adjacent gypsum board or drywall, finish and trim, floor surfaces, etc. If there is not a floor drain in this room or area, then the discharge piping must drain into the required pan of Section 504.7. As a side note, allowing the piping to simply discharge to the floor not only could damage the adjacent gypsum board and other finishes but could possibly be the source of future mold problems. The specific details and arrangement of this water heater and its discharge piping must be carefully reviewed and approved by the local building official as part of the building construction permit process.

We hope this answers your concerns in full. If you have any further questions, please call. Code opinions issued by the ICC staff are based on ICC published codes and do not include any local, state or federal codes, policies or amendments. These opinions are based on the information which you have provided. We have made no independent effort to verify the accuracy of this information nor have we conducted a review beyond the scope of your questions. These opinions do not imply approval of an equivalency, specific product, specific design or specific installation and cannot be published in any form implying such approval by the International Code Council. As these opinions are only advisory, the final decision is the responsibility of the designated authority charged with the administration and enforcement of this code.

Very truly yours,

Gary L. Nelson, P.E., C.B.O.
Senior Staff Engineer
A & E Plan Review Dept.
International Code Council, Inc.
Chicago District Office
1-888-ICC-SAFE, ext. 4311
www.iccsafe.org

From: Joe DeMaio [<mailto:JDeMaio@fortlauderdale.gov>]
Sent: Friday, February 07, 2014 12:02 PM
To: Gary Nelson
Cc: Vinas, Otto
Subject: Code interpretation

City of Fort Lauderdale
Chief Plumbing Inspector
Building Department
Joseph W. DeMaio
700 N.W. 19th Avenue
Fort Lauderdale, FL. 33311
Tel. (954) 828-5246

February 6, 2014

~~Member # 1124870:~~

Ref. International Plumbing Code 2009 edition ICC

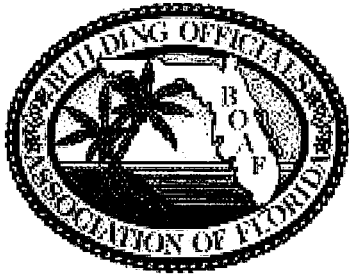
Att: Gary Nelson,

Gary, I'm contacting you today for an interpretation to Section 504.6, Item #'s 5 and 6: the discharge piping of a relief line serving a pressure relief valve can discharge onto a floor, to the pan serving a water heater or storage tank, to a waste receptor or to the outdoors. I am from Broward County, Florida. We have approximately 27 inspection agencies with 27 different Chiefs that interpret the code for each City and not all of us agree on what the intent is of this section or what it means. This is my question to the ICC that wrote the 2009 Commentary book that explains the code sections. If there is a water heater in a house on the first floor; let's say in a closet, under the stairs or under an A/C unit, laundry room, etc. and the house is finished with base board trim around the room, sheetrock on the walls, a wood door for closets, etc.; is the intent of this section for the relief line to terminate onto the floor inside a house or even a commercial building with the same inside finishes? There are no floor drains in the house close to the water

heater. The ICC's interpretation would be of a great help in enforcing the code in a more consistent manner throughout our County and the neighboring Counties. Thank you for any interpretation you can provide.

Joseph W. DeMaio
City of Fort Lauderdale

*Join us in Memphis for ICC's 2014 Committee Action Hearings in April. Experience cdpACCESS in action and help ensure the **2015 International Green Construction Code** achieves the best in energy, water and cost efficiencies from sustainable construction. [Register Now.](#)*



Florida Building Code Informal Interpretation



Date: Mon Dec 5 2005

Report #: 4077

Code: Plumbing

Section: 504.6.1

Question:

(1) Is it the intent of 504.6.1 to allow the relief line to terminate within 6" of the floor in the living space of an existing building? (2) When an existing relief line extending to the outside is present can it be used without a visible air gap located inside the same room as the water heater?

Answer:

(1) Yes it is the intent of 504.6.1 to allow the relief line to terminate within 6" of the floor in the living space of an existing building as long as it will not cause structural damage to the building or personal injury to the occupants. (2) No, there is no exception to the requirement for a visible air gap in the room with the water heater when the relief line exits the room

Commentary:

As an alternative, the FBCEB in s. 1201.2.4 provides that for alterations and repairs "An existing building or portion thereof that does not comply with the requirements of this code for new construction shall not be altered or repaired in such a manner that results in the building being less safe or sanitary than such building is currently. If, in the alteration or repair, the current level of safety or sanitation is to be reduced, the portion altered or repaired shall conform to the requirements of Chapters 2 through 36 of the Florida Building Code, Building."

Notice:

The Building Officials Association of Florida, in cooperation with the Florida Building Commission, the Florida Department of Community Affairs, ICC, and industry and professional experts offer this interpretation of the Florida Building Code in the interest of consistency in their application statewide. This interpretation is informal, non-binding and subject to acceptance and approval by the local building official.

official and concerned with evaluation of products or services that maintains periodic inspection of production of *listed equipment* or materials or periodic evaluation of services and whose listing states either that the *equipment*, material, product or service meets identified standards or has been tested and found suitable for a specified purpose.

LIVE LOADS. Those loads produced by the use and occupancy of the building or other structure and do not include construction or environmental loads such as wind load, rain load, flood load or dead load.

LIVING SPACE. Space within a *dwelling unit* utilized for living, sleeping, eating, cooking, bathing, washing and sanitation purposes.

LOT. A portion or parcel of land considered as a unit.

LOT LINE. A line dividing one *lot* from another, or from a street or any public place.

MACERATING TOILET SYSTEMS. A system comprised of a sump with macerating pump and with connections for a water closet and other plumbing fixtures, that is designed to accept, grind and pump wastes to an *approved* point of discharge.

MAIN. The principal pipe artery to which branches may be connected.

MAIN SEWER. See “Public sewer.”

MANIFOLD WATER DISTRIBUTION SYSTEMS. A fabricated piping arrangement in which a large supply main is fitted with multiple branches in close proximity in which water is distributed separately to fixtures from each branch.

MANUFACTURED HOME. *Manufactured home* means a structure, transportable in one or more sections, which in the traveling mode is 8 body feet (2438 body mm) or more in width or 40 body feet (12 192 body mm) or more in length, or, when erected on site, is 320 square feet (30 m²) or more, and which is built on a permanent chassis and designed to be used as a *dwelling* with or without a permanent foundation when connected to the required utilities, and includes the plumbing, heating, air-conditioning and electrical systems contained therein; except that such term shall include any structure that meets all the requirements of this paragraph except the size requirements and with respect to which the manufacturer voluntarily files a certification required by the secretary (HUD) and complies with the standards established under this title. For mobile homes built prior to June 15, 1976, a *label* certifying compliance to the Standard for Mobile Homes, NFPA 501, in effect at the time of manufacture is required. For the purpose of these provisions, a mobile home shall be considered a *manufactured home*.

MANUFACTURER'S DESIGNATION. An identification applied on a product by the manufacturer indicating that a product or material complies with a specified standard or set of rules. (See also “*Mark*” and “*Label*.”)

MANUFACTURER'S INSTALLATION INSTRUCTIONS. Printed instructions included with *equipment* as part of the conditions of listing and labeling.

MARK. An identification applied on a product by the manufacturer indicating the name of the manufacturer and the function of a product or material. (See also “Manufacturer’s designation” and “*Label*.”)

MASONRY CHIMNEY. A field-constructed chimney composed of solid masonry units, bricks, stones or concrete.

MASONRY HEATER. A masonry heater is a solid fuel burning heating *appliance* constructed predominantly of concrete or solid masonry having a mass of at least 1,100 pounds (500 kg), excluding the chimney and foundation. It is designed to absorb and store a substantial portion of heat from a fire built in the firebox by routing exhaust gases through internal heat exchange channels in which the flow path downstream of the firebox includes at least one 180-degree (3.14-rad) change in flow direction before entering the chimney and which deliver heat by radiation through the masonry surface of the heater.

MASONRY, SOLID. Masonry consisting of solid masonry units laid contiguously with the joints between the units filled with mortar.

MASONRY UNIT. Brick, tile, stone, glass block or concrete block conforming to the requirements specified in Section 2103 of the *Florida Building Code, Building*.

Clay. A building unit larger in size than a brick, composed of burned clay, shale, fire clay or mixtures thereof.

Concrete. A building unit or block larger in size than 12 inches by 4 inches by 4 inches (305 mm by 102 mm by 102 mm) made of cement and suitable aggregates.

Glass. Nonload-bearing masonry composed of glass units bonded by mortar.

Hollow. A masonry unit whose net cross-sectional area in any plane parallel to the loadbearing surface is less than 75 percent of its gross cross-sectional area measured in the same plane.

Solid. A masonry unit whose net cross-sectional area in every plane parallel to the loadbearing surface is 75 percent or more of its cross-sectional area measured in the same plane.

MASS WALL. Masonry or concrete walls having a mass greater than or equal to 30 pounds per square foot (146 kg/m²), solid wood walls having a mass greater than or equal to 20 pounds per square foot (98 kg/m²), and any other walls having a heat capacity greater than or equal to 6 Btu/ft² · °F [266 J/(m² · K)].

MATERIAL CODE VIOLATION. A material code violation is a violation that exists within a completed building, structure or facility which may reasonably result, or has resulted, in physical harm to a person or significant damage to the performance of a building or its systems.

MATERIAL VIOLATION. As defined in Florida Statutes.

MEAN ROOF HEIGHT. The average of the roof eave height and the height to the highest point on the roof surface, except that eave height shall be used for roof angle of less than or equal to 10 degrees (0.18 rad).

MEANS OF ESCAPE. A way out of a building or structure that does not conform to the strict definition of means of egress



City of Deerfield Beach Building Division
150 NE 2 Avenue, Deerfield Beach, Florida 33441
Telephone: (954) 480-4250 / Fax: (954) 422-5812

1 f.

WATER HEATER REPLACEMENT
(WATER HEATER STAYING IN SAME LOCATION)

JOB NAME: _____

ADDRESS: _____

"EXISTING UNIT TO BE REPLACED"

ELECTRIC

GAS

Kw: _____

VOLTAGE: _____

WIRE SIZE: _____

BREAKER SIZE: _____

GALLONS: _____

GAS PIPE SIZE: _____

FLUE SIZE & TYPE: _____

BTUHs: _____

GALLONS: _____

"NEW UNIT BEING INSTALLED"

Manufacturer's installation instructions must be provided with permit application.

ELECTRIC

GAS

MAKE: _____

MODEL# _____

Kw: _____

VOLTAGE: _____

WIRE SIZE: _____

BREAKER SIZE: _____

GALLONS: _____

MAKE: _____

MODEL# _____

IGNITER CIRCUIT: NEW EXISTING N/A (circle one)

GAS PIPE SIZE: _____

FLUE SIZE & TYPE: _____

BTUHs: _____

GALLONS: _____

GAS:

Does the combustion air meet the FL Fuel Gas Code; sec. 304? :

YES: ___

NO: ___

If no, submit drawing showing sizes and locations.

ELECTRIC:

a.) Is there any new electrical wiring required for this water heater replacement? :

YES: ___

NO: ___

b.) Cord and plug water heater connections may only be used if permitted by the manufacturer's installation instructions as per NEC 422.16(A) and if the water heater is listed by a NRTL for a cord and plug connection.

COMPANY NAME: _____

QUALIFIERS SIGNATURE: _____

CONTRACTORS LIC. #: _____



Town of Hillsboro Beach Building Division
 1210 Hillsboro Mile, Hillsboro Beach, FL 33062
 Telephone: (954) 427-4011 / Fax: (954) 427-4834

WATER HEATER REPLACEMENT
(WATER HEATER STAYING IN SAME LOCATION)

JOB NAME: _____

ADDRESS: _____

“EXISTING UNIT TO BE REPLACED”

ELECTRIC

GAS

Kw: _____
 VOLTAGE: _____
 WIRE SIZE: _____
 BREAKER SIZE: _____
 GALLONS: _____

GAS PIPE SIZE: _____
 FLUE SIZE & TYPE: _____
 BTUHs: _____
 GALLONS: _____

“NEW UNIT BEING INSTALLED”

Manufacturer’s installation instructions must be provided with permit application.

ELECTRIC

GAS

MAKE: _____
 MODEL# _____
 Kw: _____
 VOLTAGE: _____
 WIRE SIZE: _____
 BREAKER SIZE: _____
 GALLONS: _____

MAKE: _____
 MODEL# _____
 IGNITER CIRCUIT: NEW EXISTING N/A (circle one)
 GAS PIPE SIZE: _____
 FLUE SIZE & TYPE: _____
 BTUHs: _____
 GALLONS: _____

GAS:

Does the combustion air meet the FL Fuel Gas Code; sec. 304? : YES:___ NO:___
 If no, submit drawing showing sizes and locations.

ELECTRIC:

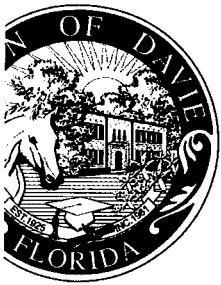
a.) Is there any new electrical wiring required for this water heater replacement? : YES:___ NO:___

b.) Cord and plug water heater connections may only be used if permitted by the manufacturer’s installation instructions as per NEC 422.16(A) and if the water heater is listed by a NRTL for a cord and plug connection.

COMPANY NAME: _____

QUALIFIERS SIGNATURE: _____

CONTRACTORS LIC. #: _____



ADMINISTRATION DEPARTMENT
BUILDING DIVISION

6591 ORANGE DRIVE • DAVIE, FLORIDA 33314
PHONE: 954.797.1111 • FAX: 954.797.1086 • WWW.DAVIE-FL.GOV

**WATER HEATER REPLACEMENT DATA FORM
2009**

Permit Number: _____

Contractor/ Owner Name: _____

Site Address: _____

Will this be an exact change out? Y___ N___ If not check below.

EXISTING

Gallons _____

Electric total watts

Gas

Heat Pump

Insta-Hot

NEW

Gallons _____

Electric total watts

Gas

Heat Pump

Insta-Hot

I DO SWEAR THAT THE INFORMATION PROVIDED ON THIS FORM IS CORRECT TO MY KNOWLEDGE

QUALIFIER/OWNER'S SIGNATURE: _____

APPROVED BY: _____

THIS FORM MUST BE POSTED WITH PERMIT CARD

Appointments can be made the day of the scheduled inspection – call between the hours of 7:30 am to 8:00 am

Plumbing: 954-797-1141

Electric – 954-797-1160

REPAIRS

[BS] 606.2 Repairs to damaged buildings. Repairs to damaged buildings shall comply with this section and Section 706, Reroofing.

[BS] 606.2.1 Repairs for less than substantial structural damage. For damage less than substantial structural damage, the damaged elements shall be permitted to be restored to their predamage condition.

[BS] 606.2.2 Substantial structural damage to vertical elements of the lateral force-resisting system. A building that has sustained substantial structural damage to the vertical elements of its lateral force-resisting system shall be evaluated in accordance with Section 606.2.2.1, and either repaired in accordance with Section 606.2.2.2 or repaired and rehabilitated in accordance with Section 606.2.2.3, depending on the results of the evaluation.

Exceptions:

1. Buildings assigned to Seismic Design Category A, B, or C whose substantial structural damage was not caused by earthquake need not be evaluated or rehabilitated for load combinations that include earthquake effects.
2. One- and two-family dwellings need not be evaluated or rehabilitated for load combinations that include earthquake effects.

[BS] 606.2.2.1 Evaluation. The building shall be evaluated by a registered design professional, and the evaluation findings shall be submitted to the code official. The evaluation shall establish whether the damaged building, if repaired to its predamage state, would comply with the provisions of the Florida Building Code, Building for load combinations that include wind or earthquake effects, except that the seismic forces shall be the reduced Florida Building Code, Building-level seismic forces.

[BS] 606.2.2.2 Extent of repair for compliant buildings. If the evaluation establishes that the building in its predamage condition complies with the provisions of Section 606.2.2.1, then the damaged elements shall be permitted to be restored to their predamage condition.

[BS] 606.2.2.3 Extent of repair for noncompliant buildings. If the evaluation does not establish that the building in its predamage condition complies with the provisions of Section 606.2.2.1, then the building shall be rehabilitated to comply with the provisions of this section. The wind loads for the repair and rehabilitation shall be those required by the building code in effect at the time of original construction, unless the damage was caused by wind, in which case the wind loads shall be in accordance with the Florida Building Code, Building. The seismic loads for this rehabilitation design shall be those required by the building code in effect at the time of original construction, but not less than the reduced Florida Building Code, Building-level seismic forces.

[BS] 606.2.3 Substantial structural damage to gravity load-carrying components. Gravity load-carrying components that have sustained substantial structural damage

shall be rehabilitated to comply with the applicable provisions for dead and live loads in the Florida Building Code, Building. Snow loads shall be considered if the substantial structural damage was caused by or related to snow load effects. Undamaged gravity load-carrying components that receive dead, live or snow loads from rehabilitated components shall also be rehabilitated if required to comply with the design loads of the rehabilitation design.

[BS] 606.2.3.1 Lateral force-resisting elements. Regardless of the level of damage to gravity elements of the lateral force-resisting system, if substantial structural damage to gravity load-carrying components was caused primarily by wind or seismic effects, then the building shall be evaluated in accordance with Section 606.2.2.1 and, if noncompliant, rehabilitated in accordance with Section 606.2.2.3.

Exceptions:

1. Buildings assigned to Seismic Design Category A, B, or C whose substantial structural damage was not caused by earthquake need not be evaluated or rehabilitated for load combinations that include earthquake effects.
2. One- and two-family dwellings need not be evaluated or rehabilitated for load combinations that include earthquake effects.

[BS] 606.2.4 Flood hazard areas. In flood hazard areas, buildings that have sustained substantial damage shall be brought into compliance with Section 1612 of the Florida Building Code, Building, or Section R322 of the Florida Building Code, Residential, as applicable.

SECTION 607 ELECTRICAL

607.1 Material. Existing electrical wiring and equipment undergoing repair shall be allowed to be repaired or replaced with like material.

607.1.1 Receptacles. Replacement of electrical receptacles shall comply with the applicable requirements of Section 406.4(D) of NFPA 70.

607.1.2 Plug fuses. Plug fuses of the Edison-base type shall be used for replacements only where there is no evidence of over fusing or tampering per applicable requirements of Section 240.51(B) of NFPA 70.

607.1.3 Nongrounding-type receptacles. For replacement of nongrounding-type receptacles with grounding-type receptacles and for branch circuits that do not have an equipment grounding conductor in the branch circuitry, the grounding conductor of a grounding-type receptacle outlet shall be permitted to be grounded to any accessible point on the grounding electrode system or to any accessible point on the grounding electrode conductor in accordance with Section 250.130(C) of NFPA 70.

607.1.4 Group I-2 receptacles. Non-“hospital grade” receptacles in patient bed locations of Group I-2 shall be replaced with “hospital grade” receptacles, as required by NFPA 99 and Article 517 of NFPA 70.

607.1.5 Grounding of appliances. Frames of electric ranges, wall-mounted ovens, counter-mounted cooking units, clothes dryers and outlet or junction boxes that are part of the existing branch circuit for these appliances shall be permitted to be grounded to the grounded circuit conductor in accordance with Section 250.140 of NFPA 70.

SECTION 608 MECHANICAL

608.1 General. Existing mechanical systems undergoing *repair* shall not make the building less conforming than it was before the *repair* was undertaken.

608.2 Mechanical draft systems for manually fired appliances and fireplaces. A mechanical draft system shall be permitted to be used with manually fired appliances and fireplaces where such a system complies with all of the following requirements:

1. The mechanical draft device shall be listed and installed in accordance with the manufacturer's installation instructions.
2. A device shall be installed that produces visible and audible warning upon failure of the mechanical draft device or loss of electrical power at any time that the mechanical draft device is turned on. This device shall be equipped with a battery backup if it receives power from the building wiring.
3. A smoke detector shall be installed in the room with the appliance or fireplace. This device shall be equipped with a battery backup if it receives power from the building wiring.

SECTION 609 PLUMBING

609.1 Materials. Plumbing materials and supplies shall not be used for repairs that are prohibited in the *Florida Building Code, Plumbing*.

609.2 Water closet replacement. The maximum water consumption flow rates and quantities for all replaced water closets shall be 1.6 gallons (6 L) per flushing cycle.

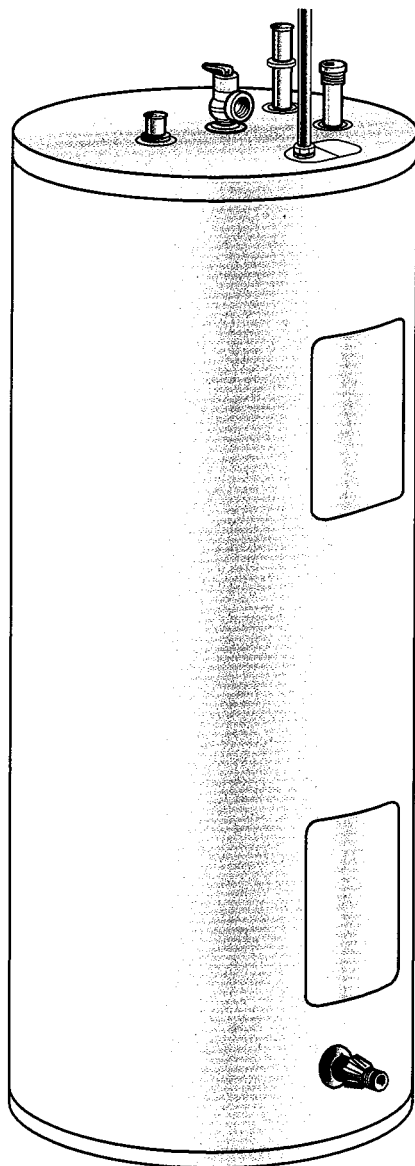
Exception: Blowout-design water closets [3.5 gallons (13 L) per flushing cycle].

Use & Care Manual

With Installation Instructions for the Installer

Electric Residential

Water Heaters



Single and Double Element Models, Residential 20-120 Gallon

Model: HE Series, GE Series, PE Series, SE Series

The purpose of this manual is twofold: one, for the contractor, to provide the installer with basic directions and recommendations for the proper installation and adjustment of the water heater; and two, for the owner-operator, to explain the features, operation, safety precautions, maintenance and trouble shooting of the water heater. This manual includes a parts list.

It is imperative that all persons who are expected to install, operate or adjust this water heater read the instructions carefully so that they may understand how to perform these operations. If you do not understand these instructions or any terms within it, seek professional advice.

Any questions regarding the operation, maintenance, service or warranty of this water heater should be directed to the seller from whom it was purchased. If additional information is required, refer to the section "If You Need Service...."

Do not destroy this manual. Please read carefully and keep in a safe place for future reference.



Recognize this symbol as an indication of Important Safety Information!



California Proposition 65 Warning: This product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.



Manufactured under trademark license by:

Rheem Manufacturing Company

P.O. Box 244020, Montgomery, AL 36124-4020

Safety Instructions	<p>Safety Information</p> <p>Safety Precautions 3, 4</p>
Installation Instructions	<p>Installation Instructions</p> <p>Location 5</p> <p>Water Connections 6</p> <p>Electrical Connections 8</p>
Operating Instructions	<p>Operating Instructions</p> <p>Safety Controls 12</p> <p>Water Temperature 13</p>
Care and Cleaning	<p>Care and Cleaning</p> <p>Draining 14</p> <p>Extended Shut-Down 14</p> <p>Maintenance..... 14</p>
Troubleshooting Tips	<p>Troubleshooting Tips</p> <p>Before You Call For Service..... 15</p>
Customer Service	<p>Customer Service</p> <p>Parts List 16</p> <p>Wiring Diagram..... 18</p> <p>Product Registration 19</p>

Safety Information

Safety Precautions 3, 4



IMPORTANT!

Fill out and return the Consumer Product Registration Card that is in the back of this manual.



FOR YOUR RECORDS

Write the model and serial numbers here:

You can find them on a label on the appliance.

Staple sales slip or cancelled check here.

Proof of the original purchase date is needed to obtain service under the warranty.



READ THIS MANUAL

Inside you will find many helpful hints on how to use and maintain your water heater properly. Just a little preventive care on your part can save you a great deal of time and money over the life of your water heater.

You'll find many answers to common problems in the Before You Call For Service section. If you review our chart of Troubleshooting Tips first, you may not need to call for service at all.



IF YOU NEED SERVICE

If you do need service, you can relax knowing help is only a phone call away. For service call 800-431-1549.



READ THE SAFETY INFORMATION

Your safety and the safety of others are very important. There are many important safety messages in this manual and on your appliance. Always read and obey all safety messages.



This is the safety alert symbol. Recognize this symbol as an indication of Important Safety Information! This symbol alerts you to potential hazards that can kill or hurt you and others.

All safety messages will follow the safety alert symbol and either the word "DANGER", "WARNING", "CAUTION" or "NOTICE".

These words mean:

▲ DANGER An imminently hazardous situation that will result in death or serious injury.

▲ WARNING A potentially hazardous situation that could result in death or serious injury and/or damage to property.

▲ CAUTION A potentially hazardous situation that may result in minor or moderate injury.

Notice: Attention is called to observe a specified procedure or maintain a specific condition.


IMPORTANT SAFETY INFORMATION. READ ALL INSTRUCTIONS BEFORE USING.



⚠️ WARNING! WATER TEMPERATURE ADJUSTMENT

Safety and energy conservation are factors to be considered when selecting the water temperature setting of water heater's thermostat. Water temperatures above 125°F can cause severe burns or death from scalding. Be sure to read and follow the warnings outlined on the label pictured below. This label is also located on the water heater near the thermostat access panel.

⚠️ DANGER



Water temperature over 125°F can cause severe burns instantly or death from scalds.

Children, disabled and elderly are at highest risk of being scalded.

See instruction manual before setting temperature at water heater.

Feel water before bathing or showering.

Temperature limiting valves are available, see manual.

NOTICE: Mixing valves are available for reducing point of use water temperature by mixing hot and cold water in branch water lines. Contact a licensed plumber or the local plumbing authority for further information.

Time/Temperature Relationship in Scalds

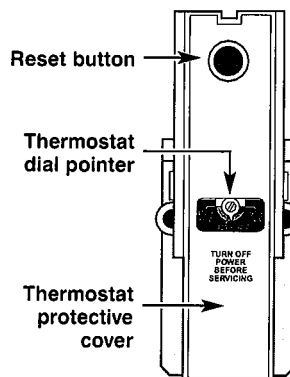
Temperature	Time To Produce a Serious Burn
120°F	More than 5 minutes
125°F	1½ to 2 minutes
130°F	About 30 seconds
135°F	About 10 seconds
140°F	Less than 5 seconds
145°F	Less than 3 seconds
150°F	About 1½ seconds
155°F	About 1 second

Table courtesy of Shriners Burn Institute

The chart shown above may be used as a guide in determining the proper water temperature for your home.

NOTICE: Households with small children, disabled, or elderly persons may require a 120°F or lower thermostat setting to prevent contact with "HOT" water.

The temperature of the water in the heater is regulated by the adjustable surface mounted thermostat(s) located behind the jacket access panel(s). Dual element heaters have two thermostats. To comply with safety regulations the thermostat(s) were set at 120°F before the water heater was shipped from the factory.



The illustration at the left shows the temperature adjustment dial used for setting the water temperature.

Refer to the Operating Instructions in this manual for detailed instructions in how to adjust the thermostat(s).

⚠️ DANGER: Hotter water increase the potential for Hot Water SCALDS.

IMPORTANT SAFETY INFORMATION. READ ALL INSTRUCTIONS BEFORE USING.

⚠ WARNING!

For your safety, the information in this manual must be followed to minimize the risk of fire or explosion, electric shock, or to prevent property damage, personal injury, or loss of life.

Be sure to read and understand the entire Use and Care Manual before attempting to install or operate this water heater. It may save you time and cost. Pay particular attention to the Safety Instructions. Failure to follow these warnings could result in serious bodily injury or death. Should you have problems understanding the instructions in this manual, or have any questions, STOP, and get help from a qualified service technician, or the local electric utility.



FOR INSTALLATIONS IN THE STATE OF CALIFORNIA

California Law requires that residential water heaters must be braced, anchored or strapped to resist falling or horizontal displacement due to earthquake motions. For residential water heaters up to 52 gallon capacity, a brochure with generic earthquake bracing instructions can be obtained from: Office of the State Architect, 400 P Street, Sacramento, CA 95814 or you may call 916-324-5315 or ask a water heater dealer.

However, applicable local codes shall govern installation. For residential water heaters of a capacity greater than 52 gallons, consult the local building jurisdiction for acceptable bracing procedures.



SAFETY PRECAUTIONS

Have the installer show you the location of the circuit breaker and how to shut it off if necessary. Turn off the circuit breaker if the water heater has been subjected to overheating, fire, flood, physical damage or if the ECO fails to shut off.

- ⓘ Read this manual entirely before installing or operating the water heater.
- ⓘ Use this appliance only for its intended purpose as described in this Use and Care Manual.
- ⓘ Be sure your appliance is properly installed in accordance with local codes and the provided installation instructions.
- ⓘ Do not attempt to repair or replace any part of your water heater unless it is specifically recommended in this manual. All other servicing should be referred to a qualified technician.



READ AND FOLLOW THIS SAFETY INFORMATION CAREFULLY.

SAVE THESE INSTRUCTIONS

Installing the water heater.

The location chosen for the water heater must take into consideration the following:

Local Installation Regulations

This water heater must be installed in accordance with these instructions, local codes, utility codes, utility company requirements or, in the absence of local codes, the latest edition of the National

Electrical Code. It is available from some local libraries or can be purchased from the National Fire Protection Association, Batterymarch park, Quincy, MA 02269 as booklet ANSI/NFPA 70.

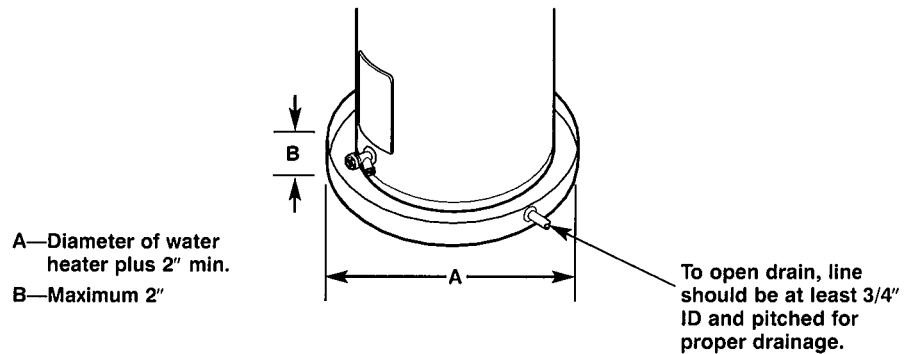
Location

Locate the water heater in a clean dry area as near as practical to the area of greatest heated water demand. Long uninsulated hot water lines can waste energy and water.

Place the water heater in such a manner that the thermostat and element access panels can be removed to permit inspection and servicing such as removal of elements or checking controls.

The water heater and water lines should be protected from freezing temperatures. Do not install the water heater in outdoor, unprotected areas.

CAUTION: The water heater should not be located in an area where leakage of the tank or connections will result in damage to the area adjacent to it or to lower floors of the structure. Where such areas cannot be avoided, it is recommended that a suitable catch pan, adequately drained, be installed under the water heater.



NOTICE: Auxiliary catch pan **MUST** conform to local codes. Catch Pan Kits are available from the store where the water heater was purchased, or any water heater distributor.

Inspect Shipment

Inspect the water heater for possible damage. Check the markings on the rating plate of the water heater to be certain the power supply corresponds to the water heater requirements.

Installing the water heater.

Thermal Expansion

Determine if a check valve exists in the inlet water line. It may have been installed in the cold water line as a separate back flow preventer, or it may be part of a pressure reducing valve, water meter or water softener. A check valve located in the cold water inlet line can cause what is referred to as a "closed water system". A cold water inlet line with no check valve or back flow prevention device is referred to as an "open" water system.

As water is heated, it expands in volume and creates an increase in the pressure within the water system. This action is referred to as "thermal expansion". In an "open" water system, expanding water which exceeds the capacity of the water heater flows back into the city main where the pressure is easily dissipated.

A "closed water system", however, prevents the expanding water from flowing back into the main supply line, and the result of "thermal expansion" can create a rapid and dangerous pressure increase in the water heater and system piping. This rapid pressure increase can quickly reach the safety setting of the relief valve, causing it to operate during each heating cycle. Thermal expansion, and the resulting rapid and repeated expansion and contraction of components in the water heater and piping system can cause premature failure of the relief valve, and possibly the heater itself. Replacing the relief valve **will not** correct the problem!

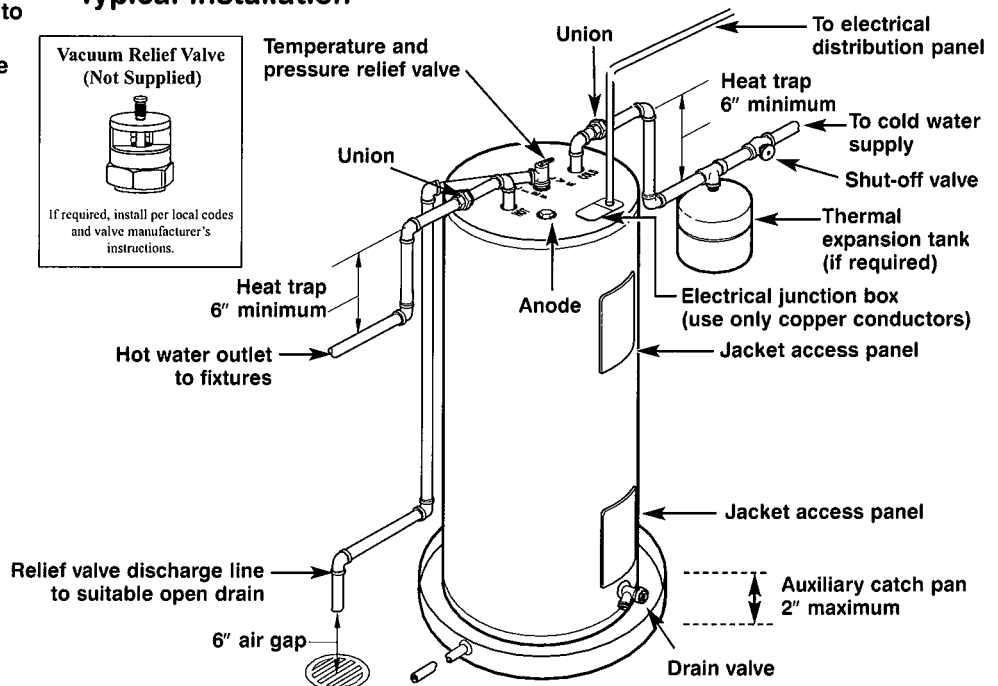
The suggested method of controlling thermal expansion is to install an expansion tank in the cold water line between the water heater and the check valve (refer to the illustration below). The expansion tank is designed with an air cushion built in that compresses as the system pressure increases, thereby relieving the over pressure condition and eliminating the repeated operation of the relief valve. Other methods of controlling thermal expansion are also available. Contact your installing contractor, water supplier or plumbing inspector for additional information regarding this subject.

Water Supply Connections

NOTICE: Do not apply heat to the HOT or COLD water connections. If sweat connections are used, sweat tubing to adapter before fitting adapter to the water connections on heater. Any heat applied to the water supply fittings will permanently damage the dip tube and/or heat traps.

Refer to the illustration below for suggested typical installation. The installation of unions or flexible copper connectors is recommended on the hot and cold water connections so that the water heater may be easily disconnected for servicing if necessary. The HOT and COLD water connections are clearly marked and are 3/4" NPT on all models. Install a shut-off valve in the cold water line near the water heater.

Typical Installation



A new combination temperature and pressure relief valve, complying with the Standard for Relief Valves and Automatic Gas Shut-Off Devices for Hot Water Supply Systems, ANSI Z21.22, is supplied and must remain installed in the opening provided and marked for the purpose on the water heater. No valve of any type should be installed between the relief valve and the tank. Local codes shall govern the installation of relief valves.

Relief Valve

⚠ WARNING: The pressure rating of the relief valve must not exceed 150 PSI, the maximum working pressure of the water heater as marked on the rating plate.

The BTUH rating of the relief valve must not be less than the input rating of the water heater as indicated on the rating label located on the front of the heater (1 watt=3.412 BTUH).

Connect the outlet of the relief valve to a suitable open drain so that the discharge water cannot contact live electrical parts or persons and to eliminate potential water damage.

Piping used should be of a type approved for hot water distribution. The discharge line must be no smaller than the outlet of the valve and must pitch downward from the valve to allow complete drainage (by gravity) of the relief valve and discharge line. The end of the discharge line should not be threaded or concealed and should be protected from freezing. No valve of any type, restriction or reducer coupling should be installed in the discharge line.

To Fill the Water Heater

⚠ WARNING: The tank must be full of water before heater is turned on. The water heater warranty does not cover damage or failure resulting from operation with an empty or partially empty tank. (Refer to the Certificate of Limited Warranty for complete terms and conditions.)

Make certain the drain valve is completely closed.

Open the shut-off valve in the cold water supply line.

Open each hot water faucet slowly to allow the air to vent from the water heater and piping.

A steady flow of water from the hot water faucet(s) indicates a full water heater.

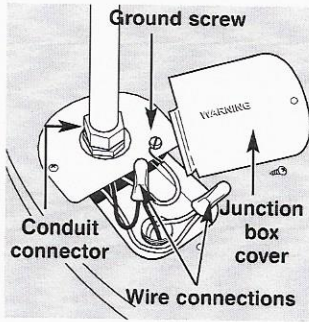
Condensation

Condensation can form on the tank when it is first filled with water. Condensation might also occur with a heavy water draw and very cold inlet water temperature.

This condition is not unusual, and will disappear after the water becomes heated. If, however, the condensation continues, examine the piping and fittings for possible leaks.

Additional information on this subject may be found at www.rheem.com under "Library". Scroll down to the Technical Service Bulletins 1300 Series Section and choose Bulletin #1303.

Installing the water heater.



Water heater junction box.

CAUTION: The presence of water in the piping and water heater does not provide sufficient conduction for a ground. Non-metallic piping, dielectric unions, flexible connectors etc. can cause the water heater to be electrically isolated.

Electrical Connections

A separate branch circuit with copper conductors, overcurrent protective device and suitable disconnecting means must be provided by a qualified electrician.

All wiring must conform to local codes or latest edition of National Electrical Code ANSI/NFPA 70.

The water heater is completely wired to the junction box inside jacket at the top front of the water heater. An opening for 1/2" or 3/4" electrical fitting is provided for field wiring connections.

The voltage requirements and wattage load for the water heater are specified on the rating plate on the front of the water heater.

The branch circuit wiring should include either:

- 1 Metallic conduit or metallic sheathed cable approved for use as a grounding conductor and installed with fittings approved for the purpose.
- 2 Non-metallic sheathed cable, metallic conduit or metallic sheathed cable not approved for use as a ground conductor shall include a separate conductor for grounding. It should be attached to the ground terminals of the water heater and the electrical distribution box.

NOTICE: This guide recommends minimum branch circuit sizing and wire size based on National Electric Code. Refer to wiring diagrams in this manual for field wiring connections.

Branch Circuit Sizing and Wire Size Guide

Total Water Heater Wattage	Recommended Over Current Protection (fuse or circuit breaker amperage rating)				Copper Wire Size AWG Based on N.E.C. Table 310-16 (75°C)			
	208V	240V	277V	480V	208V	240V	277V	480V
3,000	20	20	15	15	12	12	14	14
4,000	25	25	20	15	10	10	12	14
4,500	30	25	25	15	10	10	10	14
5,000	30	30	25	15	10	10	10	14
5,500	35	30	25	15	8	10	10	14
6,000	40	35	30	20	8	8	10	12
8,000	50	45	40	25	8	8	8	10
9,000	-	50	45	25	-	8	8	10
10,000	-	-	50	30	-	-	8	10
11,000	-	-	50	30	-	-	8	10
12,000	-	-	-	35	-	-	-	8

⚠ WARNING: If local codes require external application of insulation blanket kits the manufacturer's instructions included with the kit must be carefully followed.

Insulation Blankets

Insulation blankets, available to the general public, for external use on electric water heaters are not necessary. The purpose of an insulation blanket is to reduce the standby heat loss encountered with storage tank heaters. This water heater meets or exceeds the National Appliance Energy Conservation Act standards with respect to insulation and standby loss requirements making an insulation blanket unnecessary.

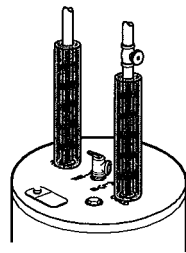
The manufacturer's warranty does not cover any damage or defect caused by installation, attachment or use of any type of energy saving or other unapproved devices (other than those authorized by the manufacturer) into, onto or in conjunction with the water heater. The use of unauthorized energy saving devices may shorten the life of the water heater and may endanger life and property.

The manufacturer disclaims any responsibility for such loss or injury resulting from the use of such unauthorized devices.

⚠ CAUTION: If local codes require the application of an external insulation blanket to this water heater, pay careful attention to the following so as not to restrict the proper function and operation of the water heater:

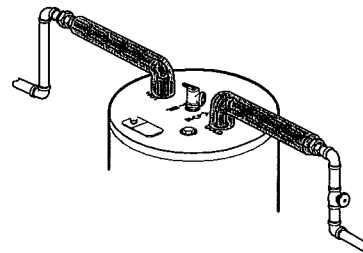
- ⦿ Do not cover the operating or warning labels attached to the water heater or attempt to relocate them on the exterior of insulation blanket.
- ⦿ Do not apply insulation to the top of the water heater. This could interfere with the safe operation of the electrical junction box.
- ⦿ Do not cover the jacket access panel(s) to the thermostat(s) and heating element(s), or pressure and temperature relief valve.
- ⦿ Inspect the insulation blanket frequently.

Hot and Cold Pipe Insulation Installation



Typical vertical piping arrangement

For increased energy efficiency, some water heaters have been supplied with two 24" sections of pipe insulation.



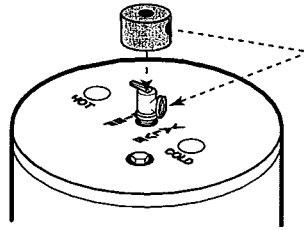
Typical horizontal piping arrangement

Please install the insulation, according to the illustrations above, that best meets your requirements.

Installing the water heater.

Relief Valve Insulation Installation

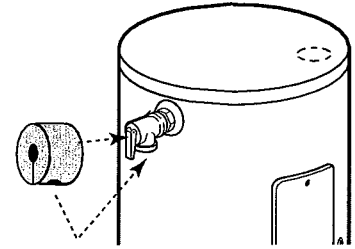
⚠ CAUTION: Ensure the T&P Valve opening is not obstructed by the insulation.



Typical top connection arrangement

For increased energy efficiency, some water heaters have been supplied with a 2-3/8" section of pipe insulation.

Please install the insulation, according to the illustrations above, that best meets your requirements.



Typical side connection arrangement

Slip the insulation cover over the T&P Valve through the center hole and align the hole in the side with the opening of the T&P Valve.

Heat Trap

For increased energy efficiency, some water heaters have been supplied with factory installed heat traps in the hot outlet line and cold water inlet line.

NOTICE: Do not apply heat to the hot or cold water connections. If sweat connections are used, sweat tubing to adapter before fitting adapter to the water connections on heater. Any heat applied to the water supply fittings will permanently damage the dip tube and/or heat traps.

Installation checklist.

A Water Heater Location

- ☑ Close to area of heated water demand.
 - ☑ Indoors and protected from freezing temperatures.
 - ☑ Area free of flammable vapors.
 - ☑ Sufficient fresh air supply for proper operation of water heater.
 - ☑ Provisions made to protect area from water damage.
 - ☑ Sufficient room to service heater.
-

B Water Supply

- ☑ Water heater completely filled with water.
 - ☑ Air purged from water heater and piping.
 - ☑ Water connections tight and free of leaks.
-

C Relief Valve

- ☑ Temperature and Pressure Relief Valve properly installed and discharge line run to open drain.
 - ☑ Discharge line protected from freezing.
-

D Wiring

- ☑ Power supply voltage agrees with water heater rating plate.
- ☑ Branch circuit wire and fusing or circuit breaker of proper size.
- ☑ Electrical connections tight and unit properly grounded.

Operating the water heater.

⚠ CAUTION: Hydrogen gas can be produced in a hot water system served by this water heater that has not been used for a long period of time (generally two weeks or more). **HYDROGEN GAS IS EXTREMELY FLAMMABLE!!** To dissipate such gas and to reduce risk of injury, it is recommended that the hot water faucet be opened for several minutes at the kitchen sink before using any electrical appliance connected to the hot water system. If hydrogen is present, there will be an unusual sound such as air escaping through the pipe as the water begins to flow. Do not smoke or use an open flame near the faucet at the time it is open.

Safety Precautions

- A** Do not turn off power to water heater if it has been subjected to over heating, fire, flood, physical damage.
- B** Do Not turn on water heater unless it is filled with water.
- C** Do Not turn on water heater if cold water supply shut-off valve is closed.
- D** If there is any difficulty in understanding or following the Operating Instructions or the Care and Cleaning section, it is recommended that a qualified person or serviceman perform the work.

Safety Controls

The water heater is equipped with a combination thermostat and temperature limiting control (ECO) that is located above the heating element in contact with the tank surface. If for any reason the water temperature becomes excessively high, the temperature limiting control (ECO) breaks the power circuit to the heating element. Once the control opens, it must be reset manually.

⚠ CAUTION: The cause of the high temperature condition must be investigated by qualified service technician and corrective action must be taken before placing the water heater in service again.

To reset the temperature limiting control:

- 1** Turn off the power to the water heater.
- 2** Remove the jacket access panel(s) and insulation.
The thermostat protective cover should not be removed.
- 3** Press the red RESET button.
- 4** Replace the insulation and jacket access panel(s) before turning on the power to the water heater.

⚠ WARNING: If the water heater has been subjected to flood, fire, or physical damage, turn off power and water to the water heater.

Do not operate the water heater again until it has been thoroughly checked by qualified service personnel.

⚠ DANGER: There is a hot water scald potential if the thermostat is set too high. Households with small children, disabled, or elderly persons may require a 120°F or lower thermostat setting to prevent contact with HOT water.

Water Temperature Setting

The temperature of the water in the water heater can be regulated by setting the temperature dial of the adjustable surface mounted thermostat(s) located behind the jacket access panel(s).

Dual element heaters have two thermostats.

Safety and energy conservation are factors to be considered when selecting the water temperature setting of the water heater's thermostat(s). The lower the temperature setting, the greater the savings in energy and operating costs.

To comply with safety regulations the thermostat(s) are factory set at 120°F or less where local codes require. This is the recommended starting point.

Water temperatures above 125°F can cause severe burns or death from scalding. Be sure to read and follow the warnings outlined in this manual and on the label on the water heater. This label is located on the water heater near the thermostat access panel.

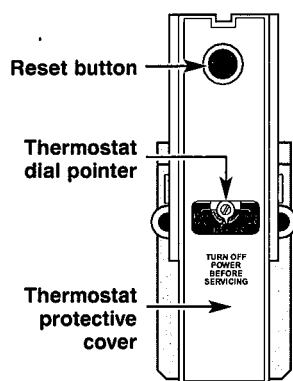
Mixing valves for reducing point of use water temperature by mixing hot and cold water in branch water lines are available. Contact a licensed plumber or the local plumbing authority for further information.

The chart below may be used as a guide in determining the proper water temperature for your home.

Time/Temperature Relationship in Scalds

Temperature	Time To Produce a Serious Burn
120°F	More than 5 minutes
125°F	1½ to 2 minutes
130°F	About 30 seconds
135°F	About 10 seconds
140°F	Less than 5 seconds
145°F	Less than 3 seconds
150°F	About 1½ seconds
155°F	About 1 second

Table courtesy of Shriners Burn Institute

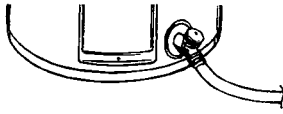


Type 59T thermostat and protective cover.

If adjustment is necessary...

- 1 Turn off the power to the water heater.
- 2 Remove the jacket access panel(s) and insulation exposing the thermostat(s).
The thermostat protective cover(s) should not be removed.
- 3 Using a small screwdriver, set the thermostat(s) dial pointer(s) to the desired temperature.
- 4 Replace the insulation and jacket access panel(s). Turn on the power to the water heater.

Care and cleaning of the water heater.



Draining the Water Heater

⚠ CAUTION: Shut off power to the water heater before draining water.

⚠ DANGER: Before manually operating the relief valve, make certain no one will be exposed to the hot water released by the valve. The water drained from the tank may be hot enough to present a scald hazard and should be directed to a suitable drain to prevent injury or damage.

In order to drain the water heater, turn off the cold water supply. Open a hot water faucet or lift the handle on the relief valve to admit air to the tank.

Attach a garden hose to the drain valve on the water heater and direct the stream of water to a drain. Open the valve.

NOTICE: Refer to the Hydrogen Gas Caution in the Operating Instructions.

Vacation and Extended Shut-Down

If the water heater is to remain idle for an extended period of time, the power and water to the appliance should be turned off to conserve energy and prevent a build-up of dangerous hydrogen gas.

The water heater and piping should be drained if they might be subjected to freezing temperatures.

After a long shut-down period, the water heater's operation and controls should be checked by qualified service personnel. Make certain the water heater is completely filled again before placing it in operation.

⚠ DANGER: Before manually operating the relief valve, make certain no one will be exposed to the danger of coming in contact with the hot water released by the valve. The water may be hot enough to create a scald hazard. The water should be released into a suitable drain to prevent injury or property damage.

Routine Preventative Maintenance

Properly maintained, your water heater will provide years of dependable trouble-free service.

It is suggested that a routine preventive maintenance program be established and followed by the user.

It is further recommended that a periodic inspection of the operating controls, heating element and wiring should be made by service personnel qualified in electric appliance repair.

Most electrical appliances, even when new, make some sound when in operation. If the hissing or singing sound level increases excessively, the electric heating element may require cleaning. Contact a qualified installer or plumbing contract to inspect.

At least once a year, lift and release the lever handle on the temperature pressure relief valve, located near the top of the water heater, to make certain the valve operates freely. Allow several gallons to flush through the discharge line to an open drain.

A water heater's tank can act as a setting basin for solids suspended in the water. It is therefore not uncommon for hard water deposits to accumulate in the bottom of the tank. It is suggested that a few quarts of water be drained from the water heater's tank every month to clean the tank of these deposits.

Rapid closing of faucets or solenoid valves in automatic water using appliances can cause a banging noise heard in a water pipe. Strategically located risers in the water pipe system or water hammer arresting devices can be used to minimize the problem.

The anode rod should be removed from the water heater's tank annually for inspection and replaced when more than 6" of core wire is exposed at either end of the rod.

Make sure the cold water supply is turned off before removing anode rod.

NOTICE: Do not remove the anode rod from the water heater's tank, except for inspection and/or replacement, as operation with the anode rod removed will shorten the life of the glass lined tank and will exclude warranty coverage.

NOTICE: If the temperature and pressure relief valve on the hot water heater discharges periodically, this may be due to thermal expansion in a closed water system. Contact the water supplier or your plumbing contractor on how to correct this. Do not plug the relief valve outlet.

Before You Call For Service...



Troubleshooting Tips
Save time and money! Review the chart on this page first and you may not need to call for service.

Problem	Possible Causes	What To Do
Rumbling noise	Water conditions in your home caused a build up of scale or mineral deposits on the heating elements.	⊕ Remove and clean the heating elements.
Relief valve producing popping noise or draining	Pressure build up caused by thermal expansion in a closed system.	⊕ This is an unacceptable condition and must be corrected. Contact the water supplier or plumbing contractor on how to correct this. Do not plug the relief valve outlet.
Rattling noise during periods of water usage	Internal heat trap fittings in operation.	⊕ This is normal for heat trap fittings when in operation and does not indicate a need for service.
Not enough or no hot water	Water usage may have exceeded the capacity of the water heater.	⊕ Wait for the water heater to recover after an abnormal demand.
	A fuse is blown or a circuit breaker tripped.	⊕ Replace fuse or reset circuit breaker.
	Electric supply may be off.	⊕ Make sure electric supply to water heater and disconnect switch, if used, are in the ON position.
	The thermostat may be set too low.	⊕ See the Temperature regulation of the water heater section of this manual.
	Leaking or open hot water faucets.	⊕ Make sure all faucets are closed.
	Electric service to your home may be interrupted.	⊕ Contact the local electric utility.
	Improper wiring.	⊕ See the Installing the water heater section of this manual.
	Manual reset limit (ECO).	⊕ See the Temperature regulation of the water heater section of this manual.
Cold water inlet temperature may be colder during the winter months.	⊕ This is normal. The colder inlet water takes longer to heat.	
Water is too hot	The thermostat is set too high.	⊕ See the Temperature regulation of the water heater section of this manual.

⚠ CAUTION: For your safety **DO NOT** attempt repair of electrical wiring, thermostats, heating elements or other safety devices. Refer repairs to qualified service personnel.

Safety Instructions

Installation Instructions

Operating Instructions

Care and Cleaning

Troubleshooting Tips

Customer Service

Replacement Parts.

For 20–120 gallon models with single and double elements.

Instructions For Placing a Parts Order

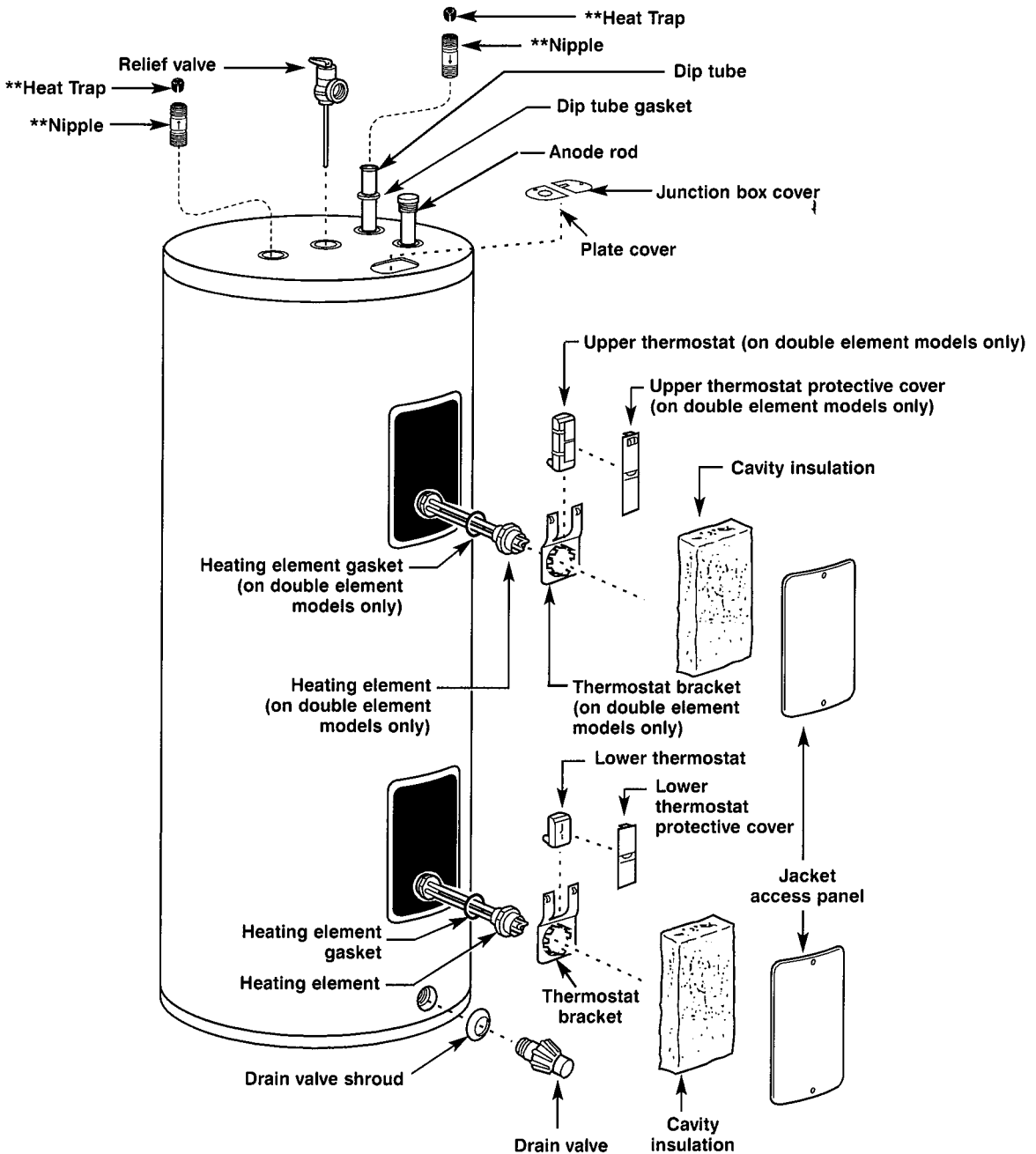
To place orders using a Visa/MasterCard call 800-431-1549.

All parts orders should include:

- 1 The model and serial number of the water heater from the rating plate.
- 2 Specify voltage and wattage as marked on the rating plate.

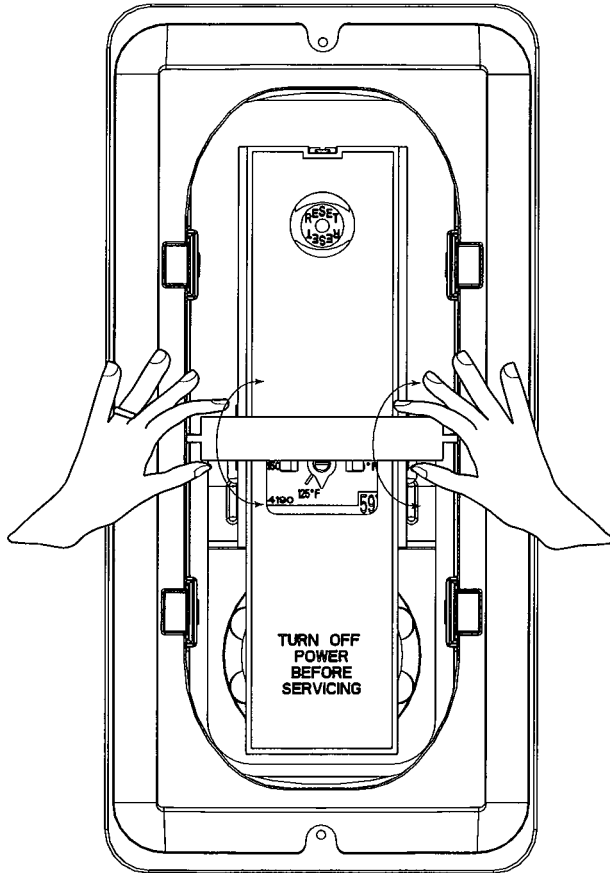
- 3 Part description (as noted below) and number of parts desired.

CAUTION: For your safety DO NOT attempt repair of electrical wiring, thermostat(s), heating elements or other operating controls. Refer repairs to qualified service personnel.



Cavity Insert Instructions

The following instructions are intended for qualified service personnel **ONLY**, and should only be done when necessary.



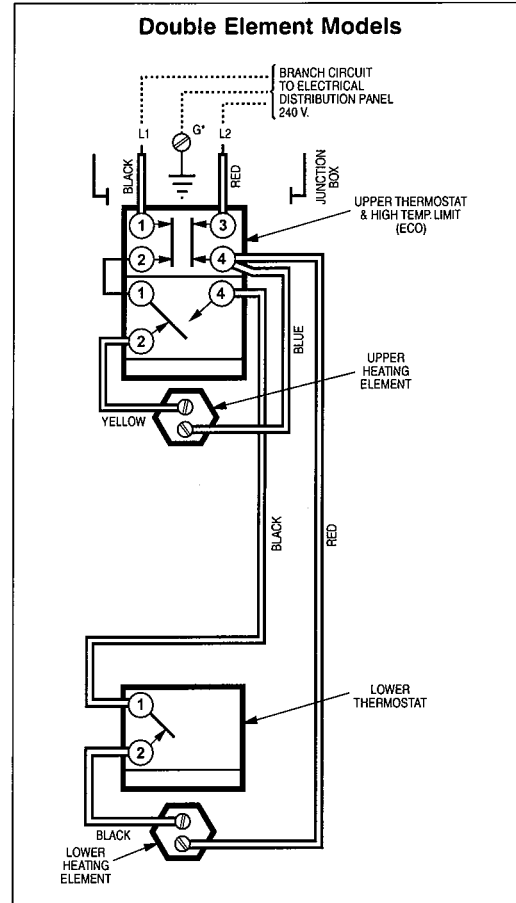
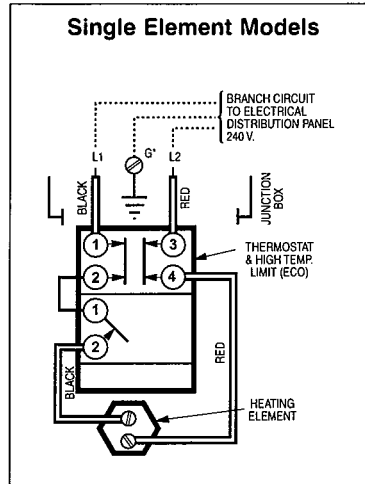
In order to replace the thermostat or heating element, remove the cavity insert crossbar by following the instructions below:


- 1 Turn off the power to the water heater.
 - 2 Remove the jacket access panel(s) and insulation.
 - 3 Rotate the crossbar up and down until it breaks away from the remainder of the cavity insert. (See illustration to the left)
- Discard the crossbar. It cannot and need not be replaced.
- 4 Replace the thermostat and/or element as necessary.
 - 5 Replace the insulation and jacket access panel(s) before turning on the power to the water heater.


NOTICE: The cavity insert crossbar is necessary for the manufacturing process only. The removal of the crossbar will not interfere with the operation of the water heater.

Wiring diagrams.

Wiring Diagrams for Type-59T Therm-o-disc Thermostats



 Cut here

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Please place in envelope and mail to:

Rheem Manufacturing Company
Warranty Registration Department
P.O. Box 34070
Louisville, KY 40232-4070

Consumer Product Ownership Registration

Follow these three steps to protect your new appliance investment:

1

Complete and mail this Consumer Product Ownership Registration today.

2

After mailing the registration below, store this document in a safe place. It contains information you will need should you require service.


3

Read your Owner's Manual carefully. It will help you operate your new appliance properly.

Model Number

Serial Number

If you require service, call 800-431-1549.

 Cut here

Consumer Product Ownership Registration



Water Heater

Model Number

Serial Number

Mr. Ms. Mrs. Miss

First Name _____

Last Name _____

Street Address _____

Apt. # _____

City _____

State _____ Zip Code _____

Date Placed in Use
Month _____ Day _____ Year _____

Phone Number _____-_____-_____

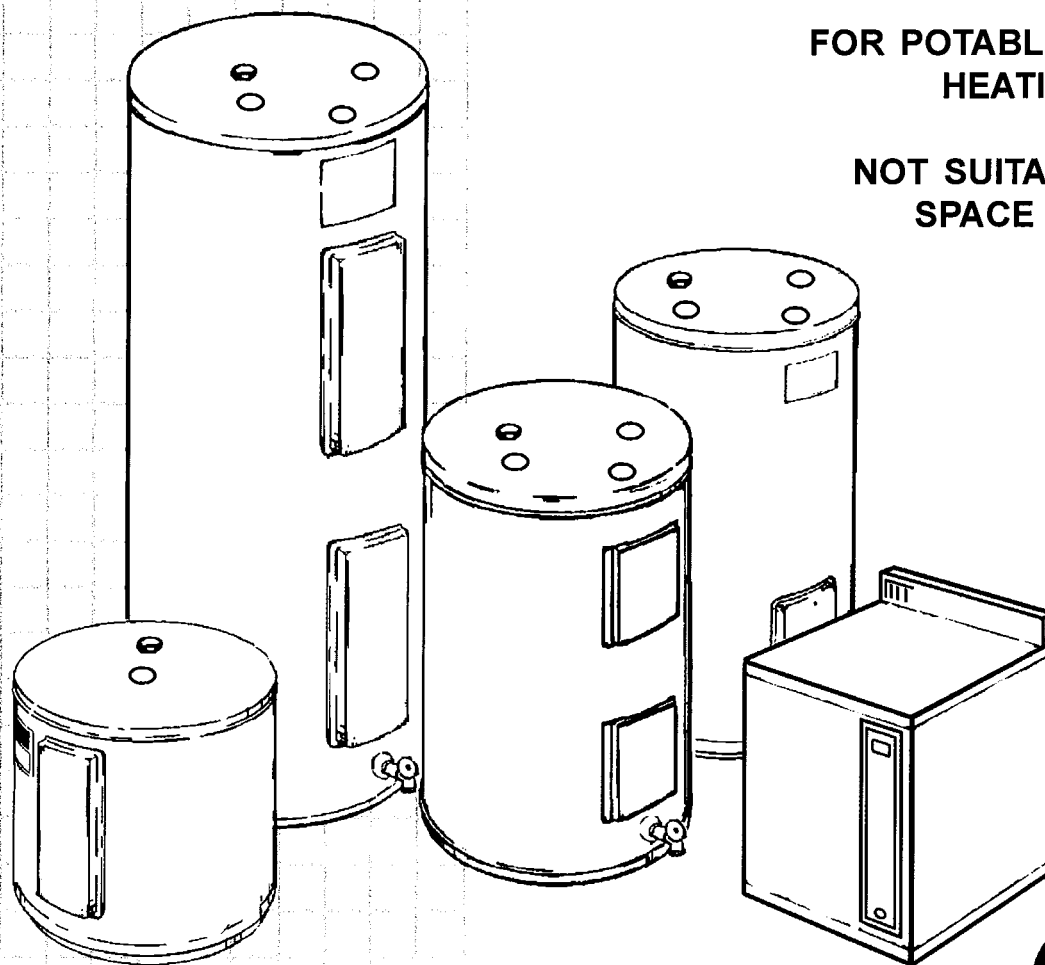
NOTICE: Failure to complete and return this card does not diminish your limited warranty rights.

A.O. Smith Water Heaters

Instruction Manual **RESIDENTIAL ELECTRIC WATER HEATERS**

**FOR POTABLE WATER
HEATING ONLY**

**NOT SUITABLE FOR
SPACE HEATING**



GAMA certification applies to all residential electric water heaters with capacities of 20 to 120 gallons. Input rating of 12 Kw or less.

	WARNING
	Read and understand instruction manual and safety messages before installing, operating or servicing this water heater.
	Failure to follow instructions and safety messages could result in death or serious injury. Instruction manual must remain with water heater.


ALL TECHNICAL AND WARRANTY QUESTIONS: SHOULD BE DIRECTED TO THE LOCAL DEALER FROM WHOM THE WATER HEATER WAS PURCHASED. IF YOU ARE UNSUCCESSFUL, PLEASE WRITE TO THE COMPANY LISTED ON THE RATING PLATE ON THE WATER HEATER.





**KEEP THIS MANUAL IN THE POCKET ON HEATER FOR FUTURE REFERENCE
WHEN EVER MAINTENANCE ADJUSTMENT OR SERVICE IS REQUIRED.**

SAFE INSTALLATION, USE AND SERVICE

Your safety and the safety of others is extremely important in the installation, use and servicing of this water heater.

Many safety-related messages and instructions have been provided in this manual and on your own water heater to warn you and others of a potential injury hazard. Read and obey all safety messages and instructions throughout this manual. It is very important that the meaning of each safety message is understood by you and others who install, use or service this water heater.

	This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.
---	--


	DANGER indicates an imminently hazardous situation which, if not avoided, could result in death or injury.
	WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or injury.
	CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.
	CAUTION used without the safety alert symbol indicates a potentially hazardous situation which, if not avoided, could result in property damage.

All safety messages will generally tell you about the type of hazard, what can happen if you do not follow the safety message and how to avoid the risk of injury.

IMPORTANT DEFINITIONS

- **Qualified Installer:** A qualified installer must have ability equivalent to a licensed tradesman in the fields of plumbing, and electrical installation of these appliances. This would include a thorough understanding of the requirements of the National Electrical Code and applicable local electrical and plumbing codes (and tools necessary to confirm proper installation and operation of the water heater) as they relate to the installation of electric water heaters. The qualified installer must have a thorough understanding of the water heater Instruction Manual.
- **Service Agency:** A service agency also must have ability equivalent to a licensed tradesman in the fields of plumbing, and electrical installation of these appliances. This would include a thorough understanding of the requirements of the National Electrical Code and applicable local electrical and plumbing codes (and tools necessary to confirm proper installation and operation of the water heater) as they relate to the installation of electric water heaters. The service agency must have a thorough understanding of the water heater Instruction Manual.

GENERAL SAFETY



⚠ WARNING

Read and understand instruction manual and safety messages before installing, operating or servicing this water heater.

Failure to follow instructions and safety messages could result in death or serious injury.

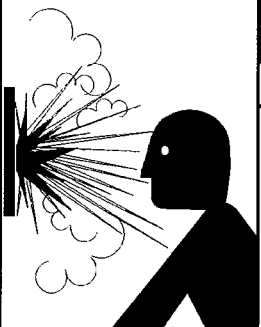
Instruction manual must remain with water heater.

CAUTION

Improper installation and use may result in property damage.

- Do not operate water heater if flood damaged.
- Inspect and replace anode.
- Install in location with drainage.
- Fill tank with water before operation.
- Be alert for thermal expansion.

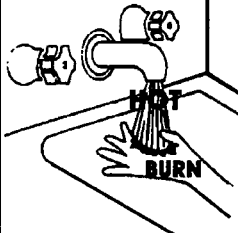
Refer to instruction manual for installation and service.



⚠ WARNING

Explosion Hazard

- Overheated water can cause watertank explosion.
- Properly sized temperature and pressure relief valve must be installed in opening provided.



⚠ DANGER


Water temperature over 125°F (52°C) can cause severe burns instantly resulting in severe injury or death.

Children, the elderly, and the physically or mentally disabled are at highest risk for scald injury.

Feel water before bathing or showering.

Temperature limiting valves are available.

Read instruction manual for safe temperature setting.



⚠ WARNING

- Before removing any access panels or servicing the water heater, make sure the electrical supply to the water heater is turned "OFF".
- Failure to do this could result in death, serious bodily injury, or property damage.

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INTRODUCTION

Thank You for purchasing this water heater. Properly installed and maintained, it should give you years of trouble free service.

Abbreviations Found In This Instruction Manual:

- ANSI - American National Standards Institute
- ASME - American Society of Mechanical Engineers
- GAMA - Gas Appliance Manufacturer's Association
- NEC - National Electric Code
- NFPA - National Fire Protection Association
- UL - Underwriters Laboratory

PREPARING FOR THE INSTALLATION

1. Read the "General Safety" section of this manual first and then the entire manual carefully. If you don't follow the safety rules, the water heater will not operate properly. It could cause **DEATH, SERIOUS BODILY INJURY AND/OR PROPERTY DAMAGE.**

This manual contains instructions for the installation, operation, and maintenance of the electric water heater. It also contains warnings throughout the manual that you must read and be aware of. All warnings and all instructions are essential to the proper operation of the water heater and your safety. Since we cannot put everything on the first few pages, **READ THE ENTIRE MANUAL BEFORE ATTEMPTING TO INSTALL OR OPERATE THE WATER HEATER.**

2. The installation must conform with these instructions and the local code authority having jurisdiction and the requirements of the power company. In the absence of code requirements follow NFPA-70 (latest edition). The National Electric Code which may be ordered from: National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02269.
3. If after reading this manual you have any questions or do not understand any portion of the instructions, call the local utility or the manufacturer whose name appears on the rating plate.
4. Carefully plan the place where you are going to put the water heater. **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.**

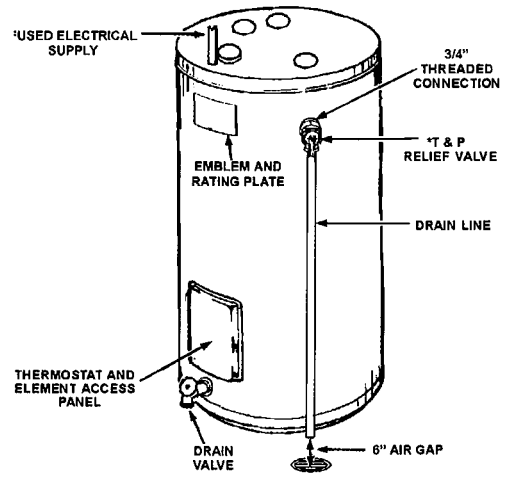
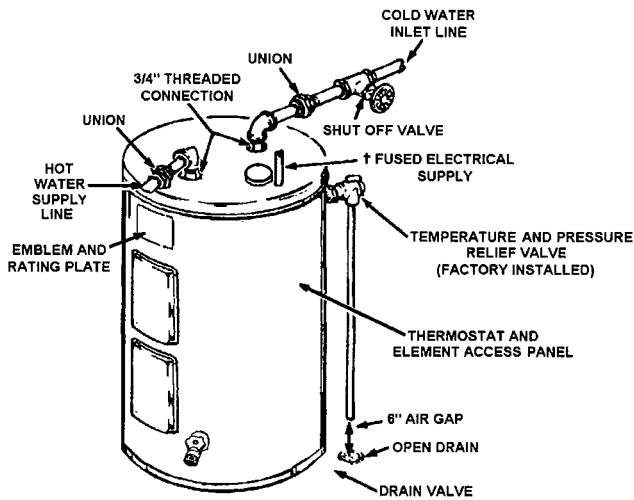
Examine the location to ensure the water heater complies with the "Facts to Consider About the Location" section in this manual.

5. For California installation this water heater must be braced, anchored, or strapped to avoid falling or moving during an earthquake. See instructions for correct installation procedures. Instructions may be obtained from California Office of the State Architect, 400 P Street, Sacramento, CA 95814.
6. Massachusetts Code requires this water heater to be installed in accordance with Massachusetts 248-CMR 2.00: State Plumbing Code and 248-CMR 5.00.

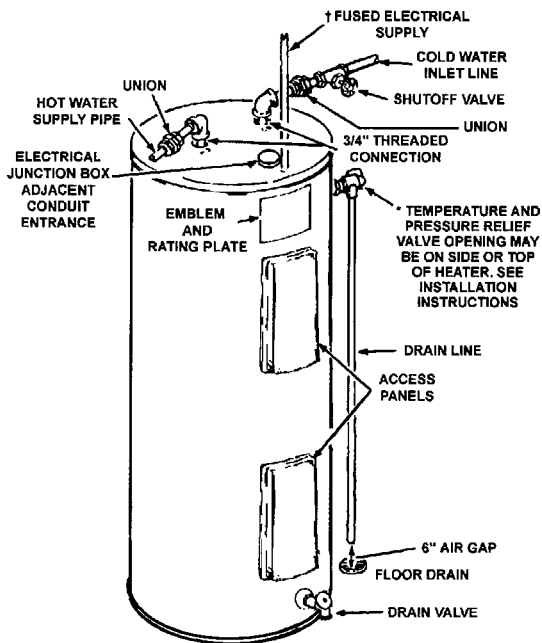
NOTES

TYPICAL INSTALLATION

LOWBOYS



UPRIGHTS



COMPACTS

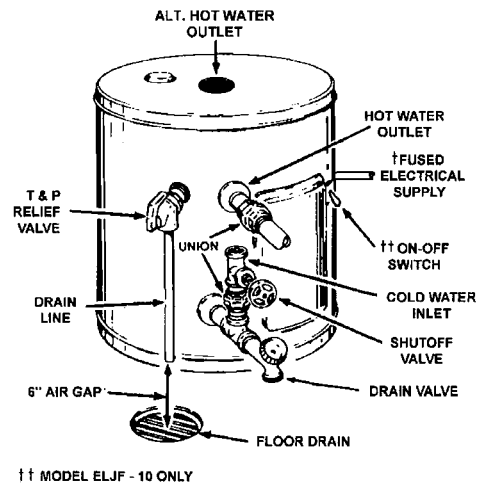
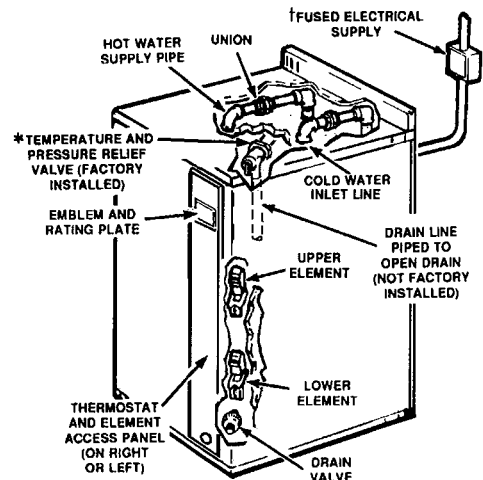


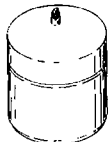
TABLE TOPS



INSTALL SUITABLE DRAIN PANS UNDER HEATERS TO PREVENT DAMAGE DUE TO LEAKAGE. REFER TO WATER HEATER LOCATION ON PAGE 8.



INSTALL VACUUM RELIEF IN COLD WATER INLET LINE AS REQUIRED BY LOCAL CODES.



INSTALL THERMAL EXPANSION TANK OR DEVICE IF WATER HEATER IS INSTALLED IN A CLOSED WATER SYSTEM.

FIGURE 1.

WIRING DIAGRAMS



⚠ WARNING

- Before removing any access panels or servicing the water heater, make sure the electrical supply to the water heater is turned "OFF".
- Failure to do this could result in death, serious bodily injury, or property damage.

TURN OFF THE HEATER ELECTRICAL SUPPLY BEFORE SERVICING ANY ELECTRICAL COMPONENTS.

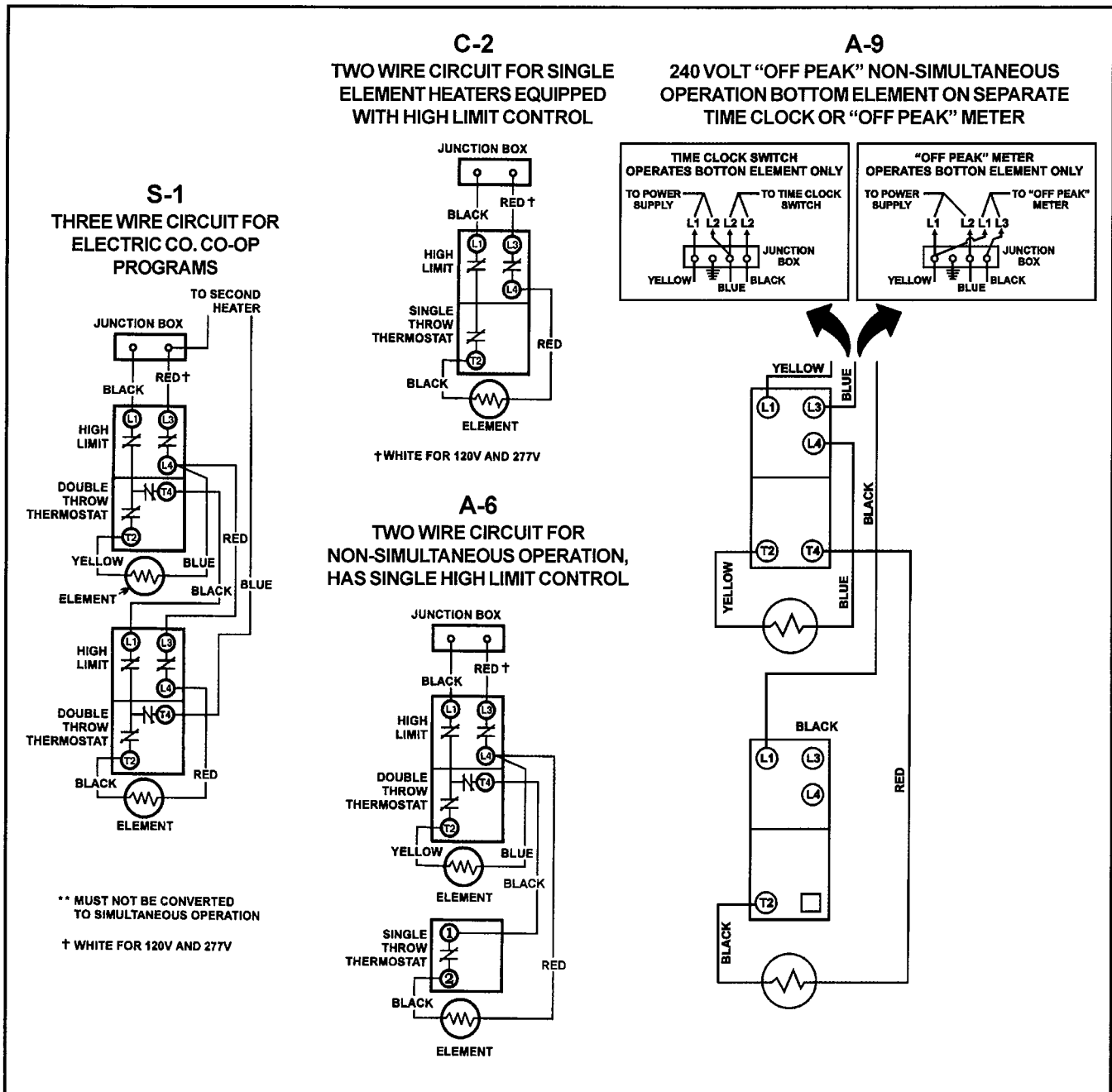


FIGURE 2.

MIXING VALVE USAGE

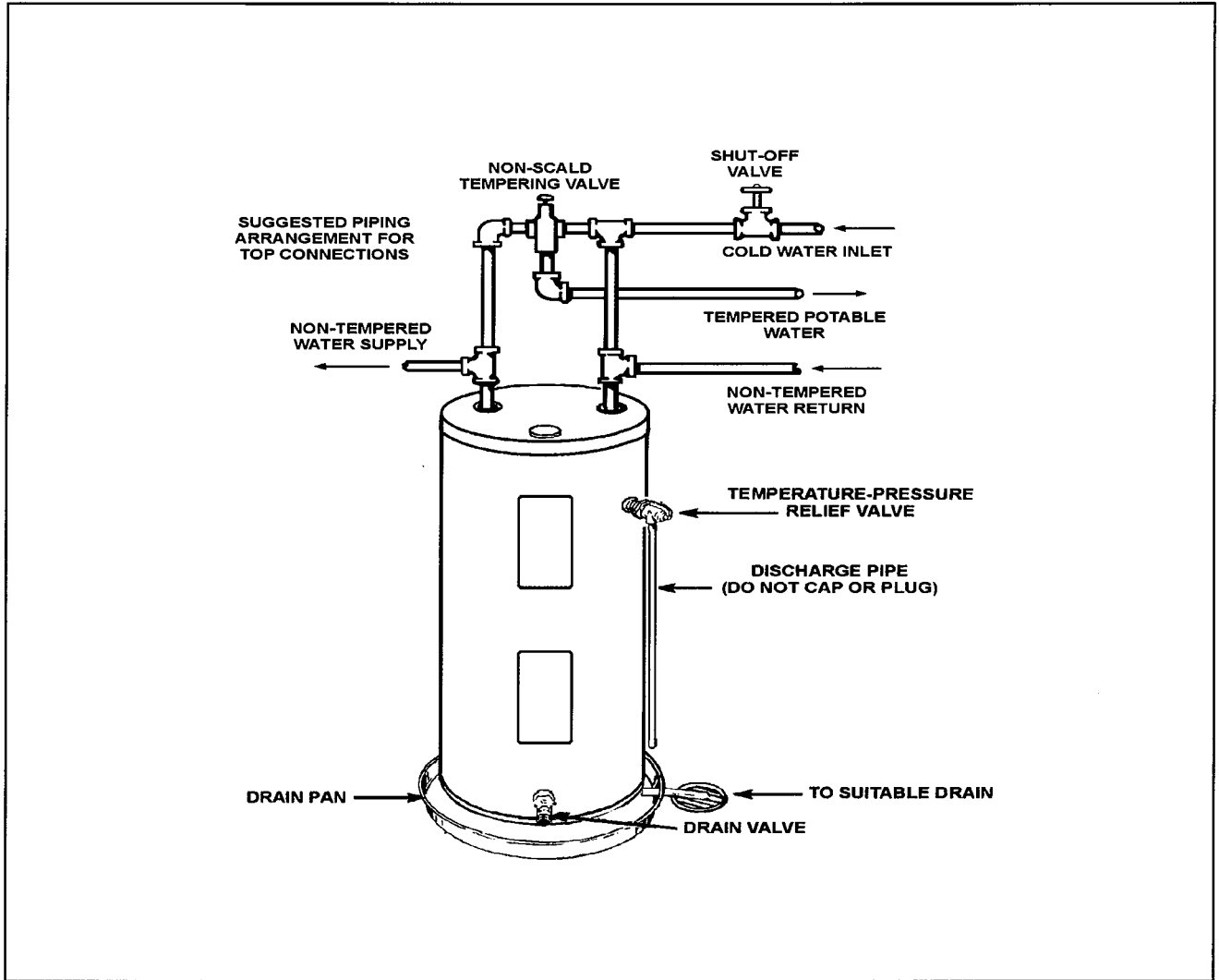


FIGURE 3.

Water (Potable) Heating: All models are considered suitable for water (potable) heating only.

HOTTER WATER CAN SCALD:

Water heaters are intended to produce hot water. Water heated to a temperature which will satisfy space heating, clothes washing, dish washing, and other sanitizing needs can scald and permanently injure you upon contact. Some people are more likely to be permanently injured by hot water than others. These include the elderly, children, the infirm, or physically/mentally handicapped. If anyone using hot water in your home fits into one of these groups or if there is a local code or state law requiring a certain temperature water at the hot water tap, then you must take special precautions. In addition to using the lowest possible temperature setting that satisfies your hot water needs, a means such as a *mixing valve, shall be used at the hot water taps used by these people or at the water heater. Mixing valves are available local plumbing contractor. Consult a Qualified Installer or Service Agency. Follow mixing valve manufacturer's instructions for installation of the valves. Before changing the factory setting on the thermostat, read the "Temperature Regulation" section in this manual.

	<p>⚠ DANGER</p> <p>Water temperature over 125°F (52°C) can cause severe burns instantly resulting in severe injury or death.</p> <p>Children, the elderly, and the physically or mentally disabled are at highest risk for scald injury.</p> <p>Feel water before bathing or showering.</p> <p>Temperature limiting valves are available.</p> <p>Read instruction manual for safe temperature setting.</p>
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LOCATING THE NEW WATER HEATER

FACTS TO CONSIDER ABOUT THE LOCATION

CAUTION

Property Damage Hazard

- All water heaters eventually leak
- Do not install without adequate drainage.

Carefully choose an indoor location for the new water heater, because the placement is a very important consideration for the safety of the occupants in the building and for the most economical use of the appliance.

Whether replacing an old water heater or putting the water heater in a new location, the following critical points must be observed:

1. Select a location indoors as close as practical or centralized to the water piping system as possible. The water heater should be located in an area not subject to freezing temperatures.
2. Selected location must provide adequate clearances (4") for servicing parts such as the thermostats, drain valve and relief valve. Adequate clearance for servicing this appliance should be considered before installation, such as changing the anodes, etc.

Installation of the water heater must be accomplished in such a manner that if the tank or any connections should leak, the flow will not cause damage to the structure. For this reason, it is not advisable to install the water heater in an attic or upper floor. When such locations cannot be avoided, a suitable drain pan should be installed under the water heater. Drain pans are available from your local plumbing contractor. Such a drain pan must have a minimum length and width of at least 2 inches (51 mm) greater than the water heater dimensions and must be piped to an adequate drain.

Water heater life depends upon water quality, water pressure and the environment in which the water heater is installed. Water heaters are sometimes installed in locations where leakage may result in property damage, even with the use of a drain pan piped to a drain. However, unanticipated damage can be reduced or prevented by a leak detector or water shut-off device used in conjunction with a piped drain pan. These devices are available from some plumbing supply wholesalers and retailers, and detect and react to leakage in various ways:

- Sensors mounted in the drain pan that trigger an alarm or turn off the incoming water to the water heater when leakage is detected.
- Sensors mounted in the drain pan that turn off the water supply to the entire home when water is detected in the drain pan.
- Water supply shut-off devices that activate based on the water pressure differential between the cold water and hot water pipes connected to the water heater.
- Devices that will turn off the gas supply to a gas water heater while at the same time shutting off its water supply.

INSULATION BLANKETS

Insulation blankets are available to the general public for external use on electric water heaters but are not necessary with this product. The purpose of an insulation blanket is to reduce the standby heat loss encountered with storage tank heaters. Your water heater meets or exceeds the National Appliance Energy Conservation Act standards with respect to insulation and standby loss requirements, making an insulation blanket unnecessary.

Should you choose to apply an insulation blanket to this heater, you should follow these instructions below. Failure to follow these instructions can result in fire, serious personal injury, or death.

- Do not cover the temperature and pressure relief (T & P) valve with an insulation blanket.
- Do not cover the instruction manual. Keep it on the side of the water heater or nearby for future reference.
- Do obtain new warning and instruction labels for placement on the blanket directly over the existing labels.

INSTALLING THE NEW WATER HEATER

WATER PIPING

▲ DANGER

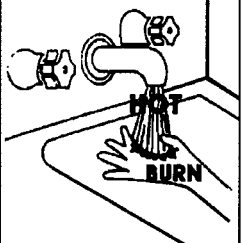
Water temperature over 125°F (52°C) can cause severe burns instantly resulting in severe injury or death.

Children, the elderly, and the physically or mentally disabled are at highest risk for scald injury.

Feel water before bathing or showering.

Temperature limiting valves are available.

Read instruction manual for safe temperature setting.



HOTTER WATER CAN SCALD:

Water heaters are intended to produce hot water. Water heated to a temperature which will satisfy space heating, clothes washing, dish washing, cleaning and other sanitizing needs can scald and permanently injure you upon contact. Some people are more likely to be permanently

injured by hot water than others. These include the elderly, children, the infirm, or physically/mentally handicapped. If anyone using hot water in your home fits into one of these groups or if there is a local code or state law requiring a certain temperature water at the hot water tap, then you must take special precautions. In addition to using the lowest possible temperature setting that satisfies your hot water needs, a means such as a *mixing valve, shall be used at the hot water taps used by these people or at the water heater. Valves for reducing point of use temperature by mixing cold and hot water are also available.

Consult a Qualified Installer or Service Agency. Follow manufacturer's instructions for installation of the valves. Before changing the factory setting on the thermostat, read the "Temperature Regulation" section in this manual.

▲ WARNING

Toxic Chemical Hazard

- Do not connect to non-potable water system.

This water heater shall not be connected to any heating systems or component(s) used with a non-potable water heating appliance.

Toxic chemicals, such as those used for boiler treatment shall not be introduced into this system.

Water supply systems may, because of such events as high line pressure, frequent cut-offs, the effects of water hammer among others, have installed devices such as pressure reducing valves, check valves, back flow preventers, etc. to control these types of problems. When these devices are not equipped with an internal by-pass, and no other measures are taken, the devices cause the water system to be closed. As water is heated, it expands (thermal expansion) and closed systems do not allow for the expansion of heated water.

The water within the water heater tank expands as it is heated and increases the pressure of the water system. If the relieving point of the water heater's temperature-pressure relief valve is reached, the valve will relieve the excess pressure. **The temperature-pressure relief valve is not intended for the constant relief of thermal expansion.** This is an unacceptable condition and must be corrected. It is recommended that any devices installed which could create a closed system have a by-pass and/or the system have an expansion tank or device to relieve the pressure built by thermal expansion in the water system. Expansion tanks are available for ordering through a local plumbing contractor. Contact the local water supplier and/or a service agency for assistance in controlling these situations.

NOTE: To protect against untimely corrosion of hot and cold water fittings, it is strongly recommended that di-electric unions or couplings be installed on this water heater when connected to copper pipe.

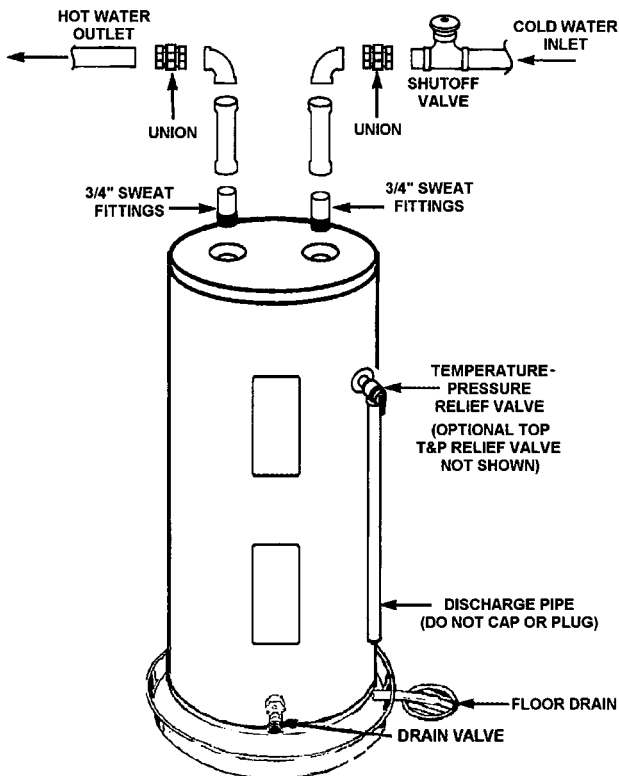


FIGURE 4.

Figure 4 shows the typical attachment of the water piping to the water heater. The water heater is equipped with 3/4 inch NPT water connections.

NOTE: If using copper tubing, solder tubing to an adapter before attaching the adapter to the cold water inlet connection. Do not solder the cold water supply line directly to the cold water inlet, it will harm the dip tube and damage the tank.

TEMPERATURE-PRESSURE RELIEF VALVE

	<h3>WARNING</h3>
	<h4>Explosion Hazard</h4> <ul style="list-style-type: none"> • Temperature-pressure relief valve must comply with ANSI Z21.22 and ASME code. • Properly sized temperature-relief valve must be installed in opening provided. • Can result in overheating and excessive tank pressure. • Can cause serious injury or death.

This heater is provided with a properly certified combination temperature - pressure relief valve by the manufacturer.

<h3>CAUTION</h3>
<h4>Property Damage Hazard</h4> <ul style="list-style-type: none"> • Avoid water heater damage. • Install thermal expansion tank if necessary. • Do not apply heat to cold water inlet. • Contact qualified installer or service agency.

The valve is certified by a nationally recognized testing laboratory that maintains periodic inspection of production of listed equipment of materials as meeting the requirements for Relief Valves and Automatic Gas Shut-off Devices for Hot Water Supply Systems, ANSI Z21.22 • CSA 4.4, and the code requirements of ASME.

If replaced, the valve must meet the requirements of local codes, but not less than a combination temperature and pressure relief valve certified as indicated in the above paragraph.

The valve must be marked with a maximum set pressure not to exceed the marked hydrostatic working pressure of the water heater (150 psi = 1,035 kPa) and a discharge capacity not less than the water heater input rate as shown on the model rating plate.

For safe operation of the water heater, the relief valve must not be removed from its designated opening nor plugged.

The temperature-pressure relief valve must be installed directly into the fitting of the water heater designed for the relief valve. Position the valve downward and provide tubing so that any discharge will exit only within 6 inches (153 mm) above, or at any distance below the structural floor. Be certain that no contact is made with any live electrical part. The discharge opening must not be blocked or reduced in size under any circumstances. Excessive length, over 30 feet (9.14 m), or use of more than four elbows can cause restriction and reduce the discharge capacity of the valve.

No valve or other obstruction is to be placed between the relief valve and the tank. Do not connect tubing directly to discharge drain unless a 6 inch air gap is provided. To prevent bodily injury, hazard to life, or property damage, the relief valve must be allowed to discharge water in quantities should circumstances demand. If the discharge pipe is not connected to a drain or other suitable means, the water flow may cause property damage.

CAUTION
Water Damage Hazard
<ul style="list-style-type: none"> • Temperature-pressure relief valve discharge pipe must terminate at adequate drain.

The Discharge Pipe:

- Shall not be smaller in size than the outlet pipe size of the valve, or have any reducing couplings or other restrictions.
- Shall not be plugged or blocked.
- Shall be of material listed for hot water distribution.
- Shall be installed so as to allow complete drainage of both the temperature-pressure relief valve, and the discharge pipe.
- Shall terminate at an adequate drain.
- Shall not have any valve between the relief valve and tank.

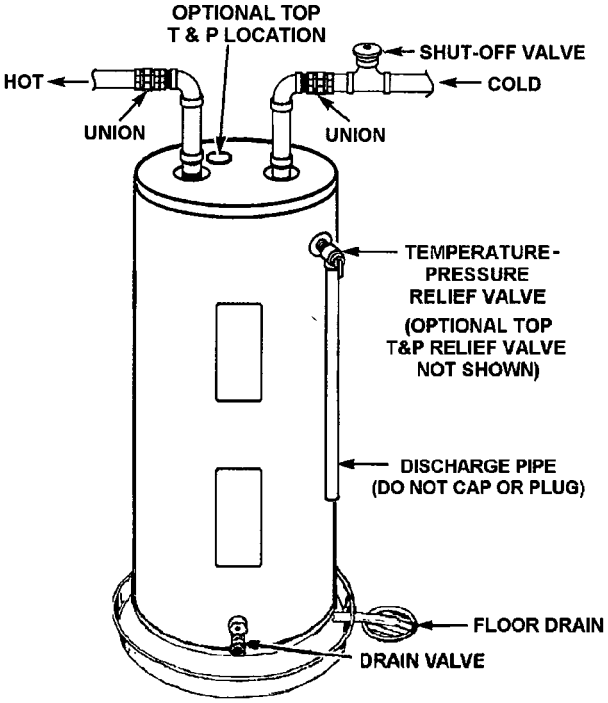


FIGURE 5.

⚠ DANGER	<p>Water temperature over 125°F (52°C) can cause severe burns instantly resulting in severe injury or death.</p> <p>Children, the elderly, and the physically or mentally disabled are at highest risk for scald injury.</p> <p>Feel water before bathing or showering.</p> <p>Temperature limiting valves are available.</p> <p>Read instruction manual for safe temperature setting.</p>

The temperature-pressure relief valve must be manually operated at least once a year. Caution should be taken to ensure that (1) no one is

in front of or around the outlet of the temperature-pressure relief valve discharge line, and (2) the water manually discharged will not cause any bodily injury or property damage because the water may be extremely hot.

If after manually operating the valve, it fails to completely reset and continues to release water, immediately close the cold water inlet to the water heater, follow the draining instructions, and replace the temperature-pressure relief valve with a new one.

FILLING THE WATER HEATER

CAUTION
Property Damage Hazard
<ul style="list-style-type: none"> • Avoid water heater damage. • Fill tank with water before operating.

Never use this water heater unless it is completely full of water. To prevent damage to the tank, the tank must be filled with water. Water must flow from the hot water faucet before turning "ON" electrical supply to the water heater.

To fill the water heater with water:

1. Close the water heater drain valve by turning the handle to the right (clockwise). The drain valve is on the lower front of the water heater.
2. Open the cold water supply valve to the water heater. **NOTE: The cold water supply valve must be left open when the water heater is in use.**
3. To insure complete filling of the tank, allow air to exit by opening the nearest hot water faucet. Allow water to run until a constant flow is obtained. This will let air out of the water heater and the piping.
4. Check all water piping and connections for leaks. Repair as needed.

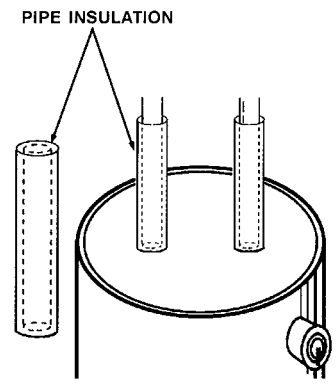


FIGURE 6.

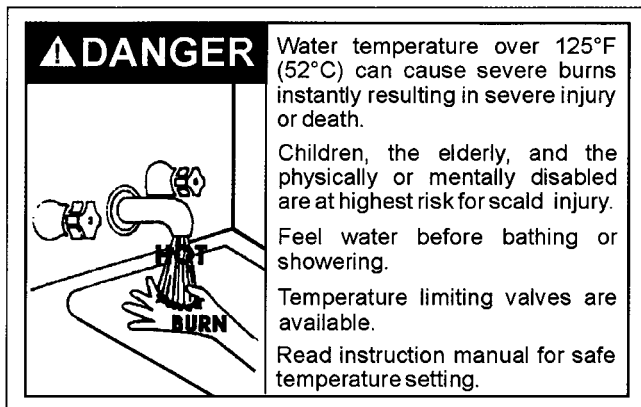
T&P VALVE and PIPE INSULATION (On Selected Models)

- Remove insulation for T&P Valve and pipe connections from carton.
- Fit pipe insulation over the incoming cold water line and the hot water line. Make sure that the insulation is against the top cover of the heater.
- Fit T&P Valve insulation over valve. Make sure that the insulation does not interfere with the lever or outlet of the T&P valve.
- Secure all insulation using tape.

TEMPERATURE REGULATION

Due to the nature of the typical water heater, the water temperature in certain situations may vary up to 30°F (16.7 °C) higher or lower at the point of use such as, bathtubs, showers, sink, etc.

Any water heater's intended purpose is to heat water. Hot water is needed for cleansing, cleaning, and sanitizing (bodies, dishes, clothing). Untempered hot water can present a scald hazard. Depending on the time element, and the people involved (adults, children, elderly, infirm, etc.) scalding may occur at different temperatures.



HOTTER WATER CAN SCALD: Water heaters are intended to produce hot water. Water heated to a temperature which will satisfy space heating, clothes washing, dish washing, and other sanitizing needs can scald and permanently injure you upon contact. Some people are more likely to be permanently injured by hot water than others. These include the elderly, children, the infirm, or physically/mentally handicapped. If anyone using hot water in your home fits into one of these groups or if there is a local code or state law requiring a certain temperature water at the hot water tap, then you must take special precautions. In addition to using the lowest possible temperature setting that satisfies your hot water needs, a means such as a mixing valve, shall be used at the hot water taps used by these people or at the water heater. Mixing valves are available from your local plumbing contractor. Follow manufacturer's instructions for installation of the valves. Before changing the factory setting on the thermostat, read the "Temperature Regulation" section in this manual.

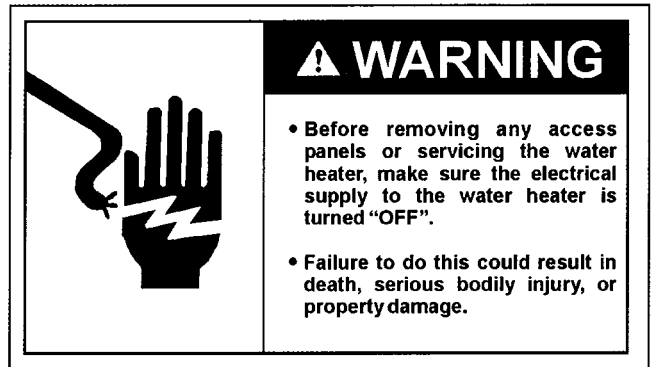
THIS WATER HEATER IS EQUIPPED WITH AN ADJUSTABLE THERMOSTAT TO CONTROL WATER TEMPERATURE. HOT WATER TEMPERATURES DESIRED FOR AUTOMATIC DISHWASHER AND LAUNDRY USE CAN CAUSE SCALDS RESULTING IN SERIOUS PERSONAL INJURY AND/OR DEATH. THE TEMPERATURE AT WHICH INJURY OCCURS VARIES WITH THE PERSON'S AGE AND THE TIME OF THE EXPOSURE. THE SLOWER RESPONSE TIME OF CHILDREN, AGED OR DISABLED PERSONS INCREASES THE HAZARDS TO THEM. NEVER ALLOW SMALL CHILDREN TO USE A HOT WATER TAP, OR TO DRAW THEIR OWN BATH WATER. NEVER LEAVE A CHILD OR DISABLED PERSON UNATTENDED IN A BATHTUB OR SHOWER.

It is recommended that lower water temperatures be used to avoid the risk of scalding. It is further recommended, in all cases, that the water temperature thermostat (See Figure 3) be set for the lowest temperature which satisfies your hot water needs. This will also provide the most energy efficient operation of the water heater. Thermostat(s) are factory set at 120°F (49°C) unless specified differently by state requirements.

KEEPING THE THERMOSTAT SETTING AT 120°F WILL REDUCE THE RISK OF SCALDS.

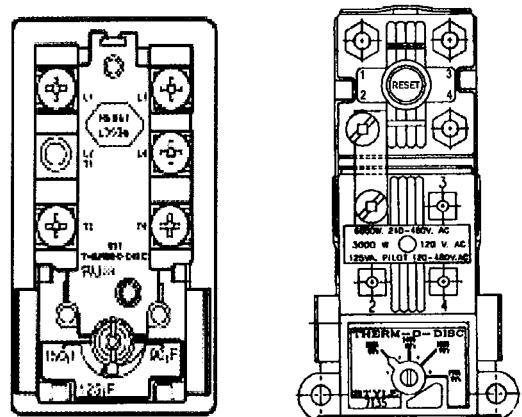
Figure 7 shows the approximate time-to-burn relationship for normal adult skin. The thermostats on your water heater have a linear relationship between degrees of angular rotation and the corresponding change in temperature. Thus rotating the temperature adjustment indicator 30 angular degrees will result in a 10 degree Fahrenheit change in water temperature.

TEMPERATURE ADJUSTMENT



To change the temperature setting:

1. Turn off the heater electrical supply. Do not attempt to adjust thermostat with power on.
2. Remove the thermostat access panels and covers from the thermostats. Do not remove the plastic personnel protectors covering the thermostats.
3. Using a flat tip screwdriver, rotate the adjustment knob to the desired temperature setting.
4. Replace the covers and access panels and turn on heater electrical supply.



Temperature Settings	Time to Produce 2nd & 3rd Degree Burns on Adult Skin
160°F (71°C)	About 1/2 second
150°F (66°C)	About 1-1/2 seconds
140°F (60°C)	Less than 5 seconds
130°F (54°C)	About 30 seconds
120°F (49°C)	More than 5 minutes
80°F (27°C)	-----

FIGURE 7.

FOR YOUR INFORMATION

THERMAL EXPANSION

CAUTION

Property Damage Hazard

- Avoid water heater damage.
- Install thermal expansion tank or device if necessary.
- Contact qualified installer or service agency.

Water supply systems may, because of such events as high line pressure, frequent cut-offs, the effects of water hammer among others, have installed devices such as pressure reducing valves, check valves, back flow preventers, etc. to control these types of problems. When these devices are not equipped with an internal by-pass, and no other measures are taken, the devices cause the water system to be closed. As water is heated, it expands (thermal expansion) and closed systems do not allow for the expansion of heated water.

The water within the water heater tank expands as it is heated and increases the pressure of the water system. If the relieving point of the water heater's temperature-pressure relief valve is reached, the valve will relieve the excess pressure. **The temperature-pressure relief valve is not intended for the constant relief of thermal expansion.** This is an unacceptable condition and must be corrected. It is recommended that any devices installed which could create a closed system have a by-pass and/or the system have an expansion tank or device to relieve the pressure built by thermal expansion in the water system. Expansion tanks are available for ordering through a local plumbing contractor. Contact the local water heater supplier or service agency for assistance in controlling these situations.

STRANGE SOUNDS

Possible noises due to expansion and contraction of some metal parts during periods of heat-up and cool-down do not necessarily represent harmful or dangerous conditions.

OPERATIONAL CONDITIONS

SMELLY WATER

In each water heater there is installed at least one anode rod (see parts sections) for corrosion protection of the tank. Certain water conditions will cause a reaction between this rod and the water. The most common complaint associated with the anode rod is one of a "rotten egg smell" in the hot water. This odor is derived from hydrogen sulfide gas dissolved in the water. The smell is the result of four factors which must all be present for the odor to develop:

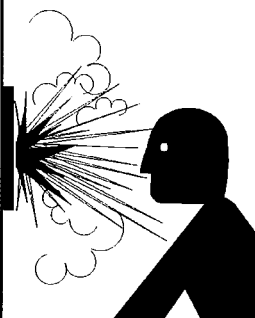
- a. A concentration of sulfate in the supply water.
- b. Little or no dissolved oxygen in the water.

- c. A sulfate reducing bacteria which has accumulated within the water heater (this harmless bacteria is nontoxic to humans).
- d. An excess of active hydrogen in the tank. This is caused by the corrosion protective action of the anode.

Smelly water may be eliminated or reduced in some water heater models by replacing the anode(s) with one of less active material, and then chlorinating the water heater tank and all hot water lines. Contact the local water heater supplier or service agency for further information concerning an Anode Replacement Kit and this chlorination treatment. If the smelly water persists after the anode replacement and chlorination treatment, we can only suggest that chlorination or aeration of the water supply be considered to eliminate the water problem.

Do not remove the anode leaving the tank unprotected. By doing so, all warranty on the water heater tank is voided.

"AIR" IN HOT WATER FAUCETS



WARNING

Explosion Hazard

- Flammable hydrogen gases may be present.
- Keep all ignition sources away from faucet when turning on hot water.

HYDROGEN GAS: Hydrogen gas can be produced in a hot water system that has not been used for a long period of time (generally two weeks or more). Hydrogen gas is extremely flammable and explosive. To prevent the possibility of injury under these conditions, we recommend the hot water faucet, located farthest away, be opened for several minutes before any electrical appliances which are connected to the hot water system are used (such as a dishwasher or washing machine). If hydrogen gas is present, there will probably be an unusual sound similar to air escaping through the pipe as the hot water faucet is opened. There must be no smoking or open flame near the faucet at the time it is open.

HIGH WATER TEMPERATURE SHUT OFF SYSTEM

A non-adjustable high temperature limit control operates before steam temperatures are reached. The high limit is in the same area as the upper thermostat and must be reset manually when it operates. **BECAUSE THE HIGH LIMIT OPERATES ONLY WHEN ABNORMALLY HIGH WATER TEMPERATURES ARE PRESENT, IT IS IMPORTANT THAT A QUALIFIED SERVICE AGENT BE CONTACTED TO DETERMINE THE REASON FOR OPERATION BEFORE RESETTING.**

PERIODIC MAINTENANCE

ANODE ROD INSPECTION

CAUTION

Property Damage Hazard

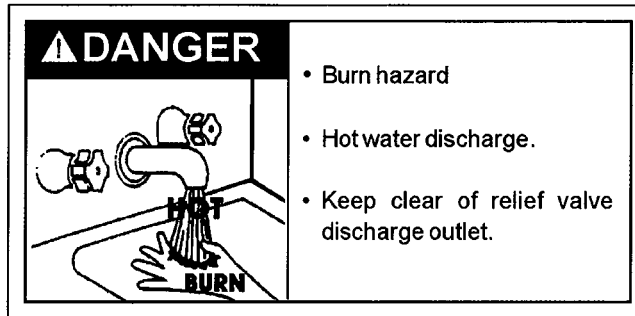
- Avoid water heater damage.
- Inspection and replacement of anode rod required.

The anode rod is used to protect the tank from corrosion. Most hot water tanks are equipped with an anode rod. The submerged rod sacrifices itself to protect the tank. Instead of corroding the tank, water ions attack and eat away the anode rod. This does not affect the water's taste or color. The rod must be maintained to keep the tank in operating condition.

Anode deterioration depends on water conductivity, not necessarily water condition. A corroded or pitted anode rod indicates high water conductivity and should be checked and/or replaced more often than an anode rod that appears to be intact. Replacement of a depleted

anode rod can extend the life of your water heater. Inspection should be conducted by a qualified technician, and at a minimum should be checked annually after the warranty period.

TEMPERATURE-PRESSURE RELIEF VALVE OPERATION



The temperature-pressure relief valve must be manually operated at least once a year.

When checking the temperature-pressure relief valve operation, make sure that (1) no one is in front of or around the outlet of the temperature-pressure relief valve discharge line, and (2) that the water discharge will not cause any property damage, as the water may be extremely hot, see Figure 8.

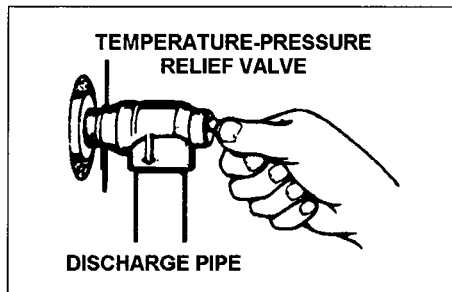
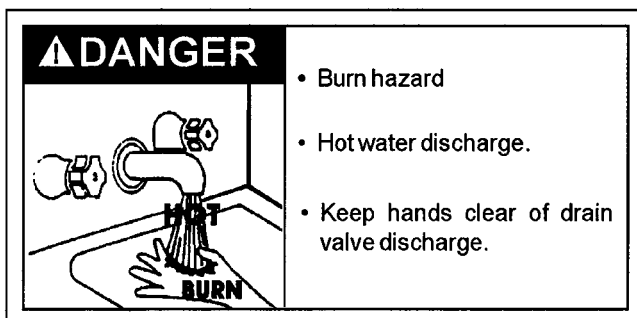


FIGURE 8.

If after manually operating the valve, it fails to completely reset and continues to release water, immediately close the cold water inlet to the water heater, follow the draining instructions, and replace the temperature-pressure relief valve with a new one.

If the temperature-pressure relief valve on the appliance weeps or discharges periodically, this may be due to thermal expansion. You may have a check valve installed in the water line or a water meter with a check valve. Consult your local water supplier or service agency for further information. Do not plug the temperature-pressure relief valve.

DRAINING



The water heater should be drained if being shut down during freezing temperatures. Also periodic draining and cleaning of sediment from the tank may be necessary.

1. Turn electrical supply "OFF".
2. CLOSE the cold water inlet valve to the water heater.
3. OPEN a nearby hot water faucet and leave open to allow for draining.
4. Connect a hose to the drain valve and terminate to an adequate drain.
5. OPEN the water heater drain valve to allow for tank draining.

NOTE: If the water heater is going to be shut down and drained for an extended period, the drain valve should be left open with hose connected allowing water to terminate to an adequate drain.

6. Close the drain valve.
7. Follow the instructions in the "Filling the Water Heater" section.

DRAIN VALVE WASHER REPLACEMENT

(See Figure 9)

1. Follow "Draining" instructions.
2. Turning counter clockwise (↺), remove the hex cap below the screw handle.
3. Remove the washer and put the new one in place.
4. Screw the handle and cap assembly back into the drain valve and retighten using a wrench. DO NOT OVER TIGHTEN.
5. Follow instructions in the "Filling The Water Heater" section.
6. Check for leaks.

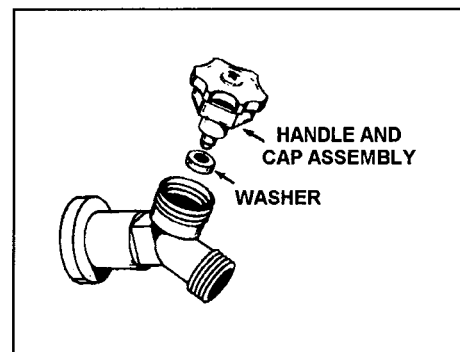


FIGURE 9.

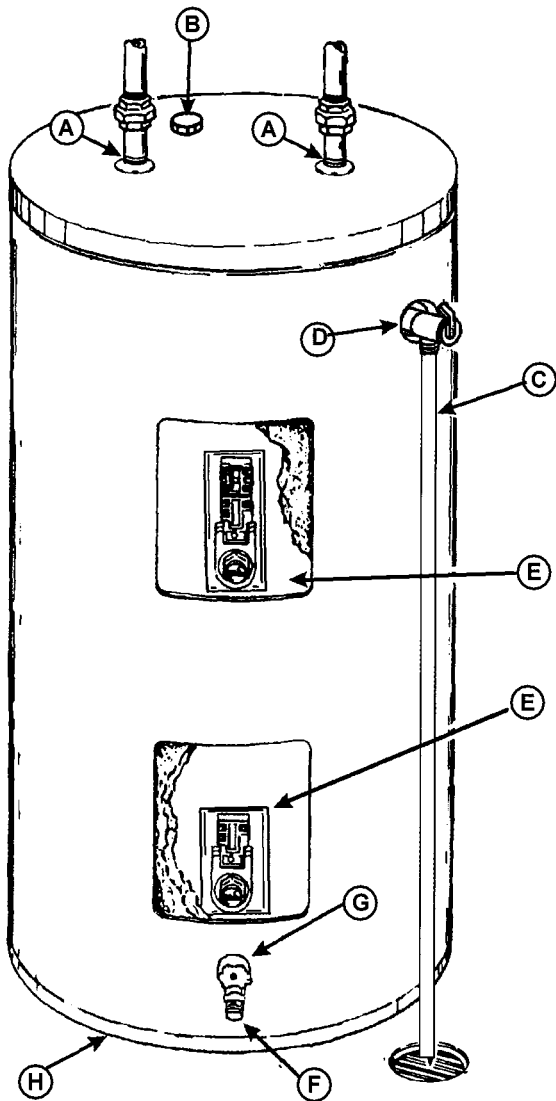
SERVICE

If a condition persists or you are uncertain about the operation of the water heater contact a service agency.

Use this guide to check a "Leaking" water heater. Many suspected "Leakers" are not leaking tanks. Often the source of the water can be found and corrected.

If you are not thoroughly familiar with your water heater and safety practices, contact a qualified installer to check the water heater.

LEAKAGE CHECKPOINTS




Read this manual first. Then before checking the water heater make sure the electrical power supply has been turned "OFF" before checking the tank for leakage.

- *A. Condensation and dripping may be seen on pipes if the water temperature is low in humid weather or pipe connections may be leaking.
- *B. The anode rod fitting may be leaking.
- C. Small amounts of water from temperature-pressure relief valve may be due to thermal expansion or high water pressure in your area. If the valve is not piped to an open drain the released water could be mistaken for a leaking heater.
- *D. The temperature-pressure relief valve may be leaking at the tank fitting.
- E. Water on the side of the tank may be condensation due to the panel or insulation not being in place.
- F. Water from a drain valve may be due to the valve being slightly opened.
- *G. The drain valve may be leaking at the tank fitting.
- *H. Water in the water heater bottom or on the floor may be from condensation, loose connections, or the relief valve. DO NOT replace the water heater until a full inspection of all possible water sources is made and necessary corrective steps taken.

Leakage from other appliances, water lines, or ground seepage should also be checked.

- * To check where threaded portion enters tank, insert cotton swab between jacket opening and fitting. If cotton is wet, follow "Draining" instructions in the "Periodic Maintenance" section and then remove fitting. Put pipe dope or teflon tape on the threads and replace. Then follow "Filling the Water Heater" instructions in the "Installing the New Water Heater" section.




⚠ WARNING

Read and understand instruction manual and safety messages before installing, operating or servicing this water heater.

Failure to follow instructions and safety messages could result in death or serious injury.

Instruction Manual must remain with water heater.



⚠ WARNING

- Before removing any access panels or servicing the water heater, make sure the electrical supply to the water heater is turned "OFF".
- Failure to do this could result in death, serious bodily injury, or property damage.

REPAIR PARTS LIST

Key No.	Part Description
1	Upper Heating Element (If Dual Element Unit)
2	Lower Heating Element
3	Element Gasket
4	Lower Thermostat (If Dual Element Unit)
5	Upper Thermostat w/ECO (If Dual Element Unit)
6	Lower Thermostat w/ECO (If Single Element Unit)
7	Outer Door(s)
8	Inlet Tube
9	Drain Valve
10	Drain Valve Washer
11	Anode Rod
12	Anode Outlet/Heat Trap (If Applicable)
13	Temperature-Pressure Relief Valve
14	External Heat Trap Nipples (If Applicable)
15	Pipe Insulation (If Applicable)
16	T&P Insulation (If Applicable)
17	Drain Pan w/Side Drain
*	Instruction Manual

*Not Illustrated

Now that you have purchased this water heater, should a need ever exist for repair parts or service, simply contact the company it was purchased from or the manufacturer listed on the rating plate on the water heater.

Be sure to provide all pertinent facts when you call or visit.

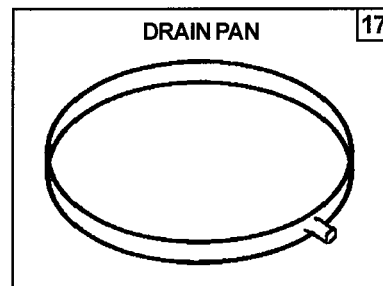
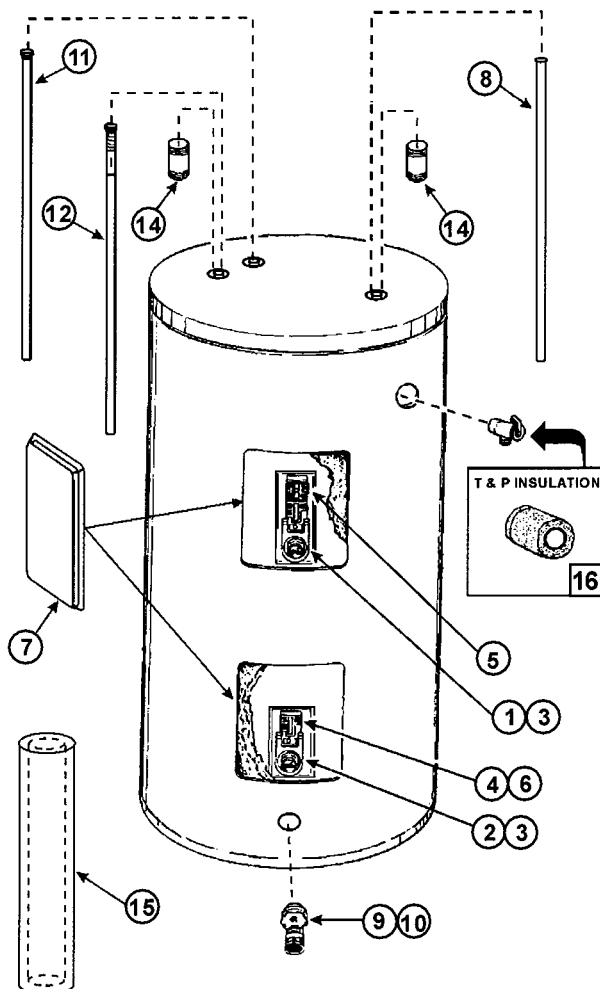
Selling prices will be furnished on request or parts will be shipped at prevailing prices and you will be billed accordingly.

The model number of your Water Heater will be found on the rating plate located above or adjacent to outer door.

WHEN ORDERING REPAIR PARTS, ALWAYS GIVE THE FOLLOWING INFORMATION:

- MODEL NUMBER
- SERIAL NUMBER
- PART DESCRIPTION

THIS IS A REPAIR PARTS LIST, NOT A PACKING LIST.



A.O. Smith
Water Heaters

www.aosmithwaterheaters.com

TROUBLESHOOTING GUIDELINES

These guidelines should be utilized by a qualified service agent.

Problem	Cause	Solution
WATER LEAKS (See Leakage Checkpoints on 14)	Improperly sealed, hot or cold supply connection, relief valve or drain valve.	Tighten threaded connections.
	Leakage from other appliances or water lines.	Inspect other appliances near water heater.
LEAKING TEMPERATURE AND PRESSURE RELIEF VALVE	Thermal expansion in closed water system.	Install thermal expansion tank (DO NOT plug T&P valve).
	Improperly seated valve.	Check relief valve for proper operation (DO NOT plug T&P valve).
HOT WATER ODORS (CAUTION: UNAUTHORIZED REMOVAL OF THE ANODE(S) WILL VOID THE WARRANTY FOR FURTHER INFORMATION, CONTACT YOUR DEALER)	High sulfate or mineral content in water supply.	Drain and flush heater thoroughly, then refill.
	Bacteria in water supply.	Chlorinate water supply.
NOT ENOUGH OR NO HOT WATER	Power supply to heater is not on.	Turn disconnect switch on or contact electrician.
	Thermostat set too low.	Refer to temperature regulation.
	Heater undersized.	Reduce hot water use.
	Incoming water is usually cold (Winter).	Allow more time for heat to reheat.
	Leaking hot water from pipes or fixtures.	Have plumber check and repair leaks.
	High temperature limit switch activated.	Contact dealer to determine cause. See temperature regulation.
HOT WATER TOO HOT	Thermostat set too high.	Refer to temperature regulation.
	High temperature limit switch activated.	Contact dealer to determine cause. See temperature regulation.
WATER HEATER SOUNDS	Scale accumulation on elements.	Contact dealer to clean or replace elements.
	Sediment build-up on tank bottom.	Drain and flush heater thoroughly, then refill.

A.O. Smith Water Heaters

RESIDENTIAL ELECTRIC WARRANTY

THIS WARRANTY IS APPLICABLE TO THE ORIGINAL OWNER ONLY. In accordance with the warranty terms and conditions specified below.

A. O. Smith Water Heaters (the warrantor) will furnish the ORIGINAL OWNER, 1) a replacement A. O. Smith water heater of equivalent size and current model if the glasslined tank in this water heater leaks and, 2) a replacement part for any component part which fails.

THE A. O. SMITH WATER HEATERS REPLACEMENT MODEL OR PART WILL BE WARRANTED FOR ONLY THE UNEXPIRED PORTION OF THE ORIGINAL WARRANTY. The warranty period will be determined by the original date of purchase of the water heater, or in the absence of a Bill of Sale verifying said date, from the date of manufacture indicated on rating plate affixed to this water heater. This warranty is not transferrable and applies to models listed below:

Series	Tank	Parts
Conservationist®	10-year	10-year
PXHT, PXHS		
ProMax® 10-Year Models	10-year	6-year
PCRT, PCRS, PCT, PCS, PCL, PCJ, PLJC, PLSC		
ProMax® 6-Year Models	6-year	6-year
ECRT, ECRS, ECT, ECS, ECL, ECJ, ELJC, ESTT, ELSC, ECLN, ECJN		

When the water heater has been used for other than single family residential application;

1. The tank warranty shall be reduced to 1 year for 6 year models and to 3 years for 10 year models.
2. The parts warranty shall be reduced to 1 year for all models.

CONDITIONS AND EXCEPTIONS

This warranty shall apply only when the water heater is installed and operated in accordance with 1) all local fire codes and plumbing codes, ordinances and regulations, 2) the printed instructions provided with it, 3) good industry practices, and 4) proper safety practices such as but not limited to a properly sized drain pan if installed in an area where leakage from the tank or its connections would result in damage to the area adjacent to the heater. In addition, a new temperature and pressure relief valve, certified by the Canadian Gas Association must have been properly installed and piped to the nearest drain.

This warranty shall apply only when the heater is:

- owned by the original purchaser;
- installed for indoor operation only;
- used at temperatures not exceeding the maximum calibrated setting of its thermostat;
- used at water pressure not exceeding the working pressure shown on the heater;
- filled with potable water, free to circulate at all times and with the tank free of damaging water sediment or scale deposits;
- used in a non-corrosive and non-contaminated atmosphere;
- used with factory approved anode(s) installed;
- in its original installation location;
- in the United States, its territories or possessions, and Canada;
- sized in accordance with proper sizing techniques for residential water heaters;
- bearing a rating plate which has not been altered, defaced or removed except as required by the warrantor;
- used in an open system or in a closed system with a properly sized and installed thermal expansion tank;
- connected to the proper voltage or:
- operated at the factory rated input;
- installed with no attempted, nor actual modification or alteration of the water heater's design in any way, including but not limited to, the attachment of non-company approved appliances or equipment.

Any accident to the water heater or any part thereof (including freezing, fire, floods, or lightning), any misuse, abuse or alteration of it, any operation of it in a modified form, any operation of the water heater on desalinated (deionized) water, or any damage caused by attempts to repair tank leaks or parts, will void this warranty. This warranty does not cover water heaters replaced for cosmetic reasons or for reasons of noise, taste, odor, discolored and/or rusty water. This warranty does not apply to water heaters used to heat pools, whirlpools or hot tubs or used for space heating where its sizing does not conform with specifications of the heating component manufacturer.

This warranty gives you specific legal rights, and you may have other rights which vary under the laws of each state. If any provision of this warranty is prohibited or invalid under applicable state law, that provision shall be ineffective to the extent of the prohibition or invalidity

without invalidating the remainder of the affected provision or the other provisions of this warranty.

SERVICE AND LABOR RESPONSIBILITY

UNDER THIS LIMITED WARRANTY, THE WARRANTOR WILL PROVIDE ONLY A REPLACEMENT WATER HEATER 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, or reinstallation of the water heater or part thereof.
- b. Shipping and delivery charges for forwarding the new water heater or replacement part from the nearest distributor and returning the claimed defective heater or part to such distributor.
- c. All cost necessary or incidental for handling and administrative charges, and for any materials and/or permits required for installation of the replacement heater or part.

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 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 limitations may not apply to you.

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 practical, the owner should contact: A.O. Smith Corporation, 5621 W. 115th Street, Alsip, Illinois 60803. Phone: 1.800.323.2636 or visit our website: www.hotwater.com.

For Canadian customers contact: A.O. Smith Enterprises LTD., P.O. Box 310, 768 Erie Street, Stratford, Ontario N5A6T3 or phone: 1.800.265.8520

Replacement Parts may be ordered through authorized servicers or distributors. Refer to your local Yellow Pages for where to call or contact A.O. Smith Corporation, 5621 W. 115th Street, Alsip, Illinois 60803. Phone: 1.800.433.2545 or visit our website at: www.hotwater.com/parts.

The warrantor will only honor replacement with identical or similar water heater or parts thereof which are manufactured or distributed by the warrantor.

Dealer replacements are made subject to in-warranty validation by warrantor.

PROOF OF PURCHASE AND PROOF OF INSTALLATION DATE ARE REQUIRED TO SUPPORT WARRANTY CLAIM FROM ORIGINAL OWNER. THIS FORM DOES NOT CONSTITUTE PROOF OF PURCHASE OR PROOF OF INSTALLATION.

DISCLAIMERS

NO EXPRESSED WARRANTY HAS BEEN OR WILL BE MADE IN BEHALF OF THE WARRANTOR WITH RESPECT TO THE MERCHANTABILITY OF THE HEATER OR THE INSTALLATION, OPERATION, REPAIR OR REPLACEMENT OF THE HEATER 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.

Should governmental regulations or industry standards prohibit the Manufacturer from furnishing a comparable model replacement under this warranty, the Owner will be furnished with the closest comparable water heater meeting the then current governmental regulations and industry standards. A supplementary fee may be assessed to cover the additional cost associated with the changes made to meet applicable regulations and standards.

IMPORTANT INFORMATION

Model Number _____

Serial Number _____

INSTALLATION INFORMATION

Date Installed _____

Company's Name _____

Street or P.O. Box _____

City, State, and Zip Code _____

Phone Number _____

Plumber's Name _____

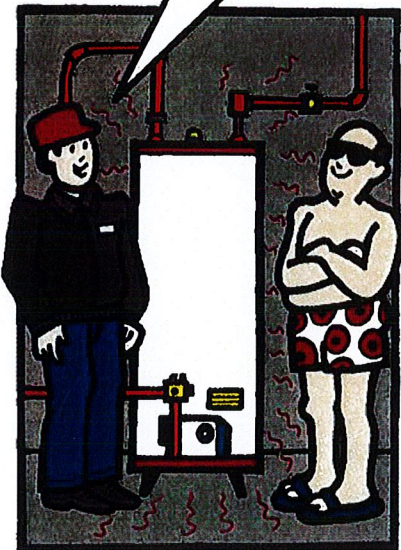


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A.O. Smith
Water Heaters

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IN GENERAL, ELECTRIC WATER HEATERS ARE NOT CONDUCTIVE TO CAUSING FIRES. THE HEAT IS WELL CONTAINED AND ABSORBED BY WATER, AND THERE ARE SEVERAL CONTROLS TO PREVENT OVERHEATING.



ELECTRIC WATER HEATER FIRES

BY MARK E. GOODSON, P.E.—One of the cardinal sins that an investigator can commit is to state that a certain type of fire can NEVER occur. Such a statement is sure to invite challenges from other investigators, as well as a barrage of questions in future depositions. It is for these reasons that the author will not state that an electric water heater cannot cause a fire. But the underlying theme of this paper is that over the years, numerous electric water heaters have been examined by the author as being potential causes of fires; not once did they turn out to be the actual cause.

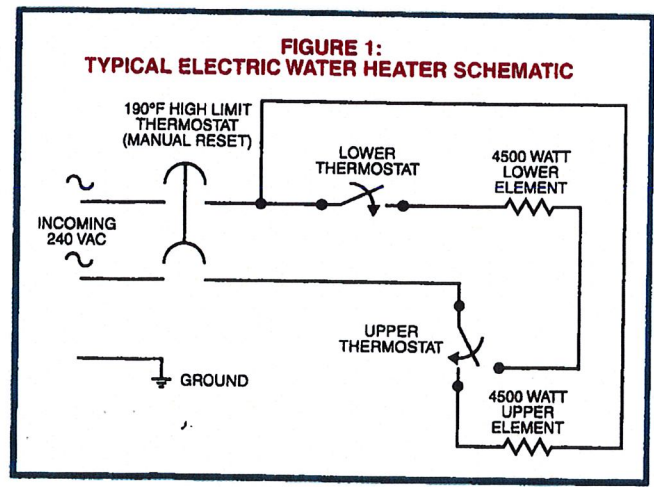
In order to investigate an electrical water heater as a fire cause, it is necessary to understand how they operate. The usual electric water heater is electrically depicted in the schematic of Figure 1. Incoming 240 VAC power first passes through a high limit thermostat, and then to one of two thermostats and resistance heaters. The resistance heaters, made of a resistance wire encased in magnesium oxide and an

outer metal sheath, are each rated at 3500 to 5500 watts. Photo 1 shows a "low boy" electrical water heater, with the cover plates removed to expose the thermostats, wiring, and heating element connections.

In use, the water heater heats incoming cold water by powering the upper heating element. Once the water temperature has risen to the setting of the upper thermostat, the upper element turns off. If the lower thermostat senses that the lower portion of the tank is cold, the lower element will be powered until the water is sufficiently hot. Temperature settings for the lower and upper elements are adjustable, with the usual range being between about 100 and 170°F. Once the water temperature has reached the desired points (as determined by the thermostats), the heating elements will stay off until the water cools (cooling occurs naturally as heat is dissipated into the atmosphere, and also when cold water enters to replace the hot water that is being consumed). The length of time that the heating elements are powered is determined by thermostat settings, inlet wa-



PHOTO 1—"Low boy" electric water heater with side covers removed showing thermostats, wiring and heating element connections.



ter temperature, heating element wattage, efficiency of the surrounding insulation, and flow rate for the exiting hot water.

While the above description of operation applies to many electric water heaters, it should be noted that some units have only 1 heating element. In addition, some smaller units (5 gallons) make use of power from a 120 VAC source. While these units are electrically different, they function in a similar manner as the 240 VAC units with 2 heating elements.

Fire causation

This writer has investigated numerous fires (35 to 40) where it was alleged that combustion was brought on by electric water heaters. In that the typical water heater has heating elements with combined ratings of about 7000 to 11,000 watts, it is often suspected of igniting nearby combustibles. However, the design of the electric water heater makes such fire causation close to impossible. Outlined here are both the theories and the realities that make such a fire scenario unlikely.

The most common allegation heard is that the heating element was responsible for the fire. This is a very doubtful scenario. In order to ignite a combustible, it is necessary to have temperatures in the neighborhood of 500 to 550°F. The heating elements, by their very design, are immersed in water. The thermostats will cut off electrical current to the heating elements if the temperature exceeds about 170°F. In the event that the operational thermostats fail, then the water temperature will rise to about 190°F. At this later point, a double pole high limit thermostat will open, cutting off power to the unit. This double pole unit usually has a manual reset button preventing cycling of the unit. The effect of this circuitry within the water heater is to keep the temperature from ever rising above about 190°F. If the water temperature is never above 190°F, then heat from a normally functioning water heater will not cause a fire by igniting nearby combustibles. Photo 2 shows a view of both an operational thermostat and the high limit switch.

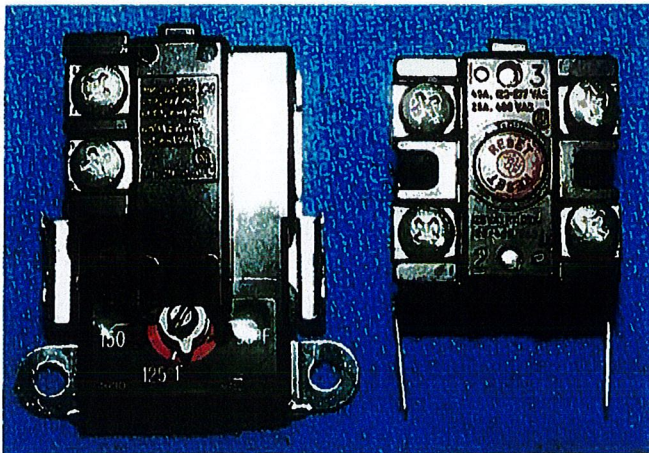


PHOTO 2—Operational thermostat and high limit switch.

The question arises as to simultaneous failures of both the operational thermostat and the high limit thermostat. In this scenario, water would continue to heat until it greatly exceeded the 212°F point (atmospheric boiling), with a fire resulting from the overheating. For this type of scenario, the operational and the high limit thermostat would have to fail, allowing continued heating of the water. Such a failure would be extremely rare. In the event that it does occur, the

PHOTO 3—The temperature & pressure valve (T&P) will prevent the tank from rupturing if the water approaches boiling by dumping the hot water outside the tank.



water temperature will rise. If we assume, however, that the water heater is plumbed according to Uniform Plumbing Code part 1007, the water heater T&P (Temperature and Pressure) valve will open. Usually set by the manufacturer at 210°F, and either 125 or 150 psi, the opening of this valve will dump the hot water outside of the tank, causing the tank to be refilled with cold water. The purpose of this valve is to prevent the tank from rupturing when the water approaches boiling pressures and temperatures. A picture of a T&P valve is shown in Photo 3.

Several water heaters examined by the author did not have water present at the time they were involved in fires. Fire investigators were curious as to whether this set of conditions

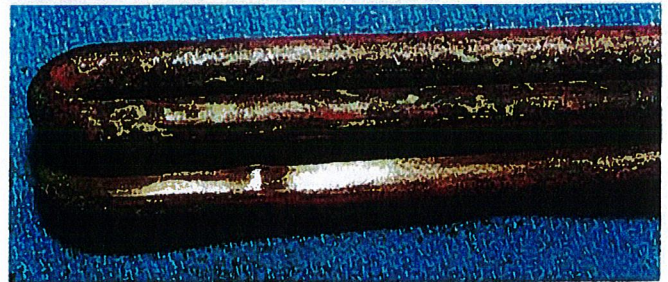


PHOTO 4—This heating element failed when “dry fired.” Note the bulge in the sheath where the failure occurred.

could lead to a fire. Most electric water heaters make use of high watt density heating elements. The design of these elements is such that they cannot be “dry fired” without immediately failing. With these types of heating elements, the water is not present to carry away the heat, and the concentration of heat at the element sheath causes the heating element to electrically open. A similar type of element can be dry fired for about 1 minute before it fails. Photo 4 shows such an element that has been dry fired and thus failed. The bulge in the sheath depicts the location where failure occurred. Needless to say, there is insufficient time available so as to cause ignition of combustibles when the tank is empty and the element is dry fired and opens.

There is a type of element that can be “dry fired” without sustaining damage. These elements are capable of functioning for a long period of time without water. The question then arises as to whether a 4500 watt resistance heater that is enclosed in a 30 or 40 gallon steel drum can create sufficient heat so as to ignite nearby combustibles. The lack of water thus changes the mechanism of heat transfer from one of conduction to convection. Testing by the author shows that the thermostats will function so as to cut off electrical current flow to the heating element. Once the temperature of the steel tank reaches the thermostat set point, the thermostat cuts off power to the heating element. The thermostats trip in the 100 to 190°F range. When these temperatures are reached on the steel tank, power will be removed. In one investigation carried out by the writer, the heating thermostat was not intimately mounted to the steel tank and did not react to the increase in temperature caused by dry firing. The thermoplastic insulation on the power wiring to the thermostat failed from the heat buildup,

and a short occurred between the grounded tank and the wiring. This short tipped a breaker, and the power was removed.

The one area of a water heater that would be prone to cause problems would be the connections. This observation is true with not only water heaters, but almost any electrical device that carries sizeable amounts of electrical current. Connections that are loose or improperly made can overheat and cause fires if combustible materials are too close. Photo 5 shows the thermal image of a water heater with one

PHOTO 5—This thermal image shows the results of loosened connections on the thermostat and high limit switch of an electric water heater.



of the side covers removed. The high limit switch, thermostat, and heating element are all present. The connections on the left hand side of the high limit switch and thermostat have been backed off about 1/4 turn, with the results being obvious.

Incoming power is normally brought to the water heater by #10 AWG solid copper wire. With the water heater on continually (i.e., hot water constantly leaving with cold water entering the tank), the temperature rise of this copper wire is barely perceptible in a nominal 75°F atmosphere. Using #12 and #14 wires to bring power to the same water heater with 4500 watt elements, steady state temperature rises of 91 and 102°F, respectively, were found. It is certainly against the electrical code to overload these wires in this fashion, but no short term damage to the wiring was seen with this level of overloading. The astute investigator will check the wire sizes, breaker position, breaker rating, and connections to the water heater after a fire to determine if there is any evidence of code violations or connector problems with the wiring.

The thermal insulation on water heaters consists of both fiberglass fibers and a type of urethane foam. Obviously, the fiberglass will not combust in a fire. The author has seen several types of foam that have been used in water heaters; some do not support combustion, while others were readily ignited under some circumstances. The best test when examining a given fire scene is to take some of the foam from an exemplar heater and determine whether it can sustain a flame on its own. If the foam readily combusts, one must determine what the heat source (if any) was. Did the foam ignite early in the fire (a possible cause)? In terms of combustibles, the foam and the insulation on the wiring are about the only combustibles that an electric

water heater has. Absent any arcing within the wiring in the water heater, it is very unlikely that the foam was ignited by an internal source. It should also be pointed out that if the urethane foam will combust well in free air, it is very unlikely to effectively combust in a closed space. The foam is well sandwiched by an outer sheet metal skin and an inner steel tank. Unless the two steel cover plates have been removed from the outer skin, there is simply insufficient oxygen available to allow for proper oxygenation of the urethane foam inside the unit.

This writer has seen one water heater in which electrical operation was verifiably not proper and which the homeowner suspected of causing a fire. The homeowner stated that several days prior to the fire, he had to manually reset the high limit thermostat overload switch by depressing its red button. A fire occurred about 48 hours later, and the water heater was suspected. Inspection revealed that on this water heater, the thermostats would have had no effect in controlling water temperature. Corrosion had attacked the lower element internal to the tank, causing the element to short out to its inner sheath; Photo 6 shows this heating element, as well as the good upper unit. When this corrosive process and resultant failure occurs, the heating element turns into a lower wattage unit and is given power by the upper thermostat and the ground connection of the sheath. Water will continually heat, albeit slowly. Because the lower thermostat in this scenario is bypassed, the water will continue to overheat until the 190°F point is reached and the high limit thermostat is tripped. While this scenario is unsafe from both scalding and electrical shock standpoints, it is not causative of a fire.

Throughout this paper, the writer has assumed that the water heater

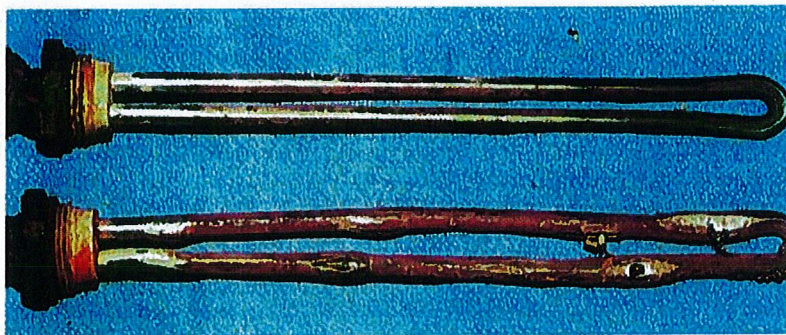


PHOTO 6—Corrosion caused the lower element to fall by shorting out to its inner sheath. The still good upper element is shown at the top.

is properly installed in accordance with both NEC and UPC requirements. If these requirements are not met, then some of the comments made do not apply. As an example, NEC requirements state that an appliance must be installed and used in its intended fashion. If the installer has left the cover plates off of the water heater at either the heating elements or the wiring inlet, then obviously the risk increases for ignition of combustibles by a shorting/arcing process.

Summary

In general, electric water heaters do not cause fires. The majority of the heat is well contained and absorbed by water. There are several electrical controls present which are intended to prevent overheating. Should these controls fail, the T&P valve will cause cold water to purge the tank, thus eliminating the chances for fires. When water is lost from a tank, most heating elements are designed to immediately open. Water heaters do use a power source (240 VAC, 30 ampere

breaker) that is capable of delivering substantial amounts of power. In most cases an overheated connection, a direct short of the hot wire or a loose wire that shorts to ground (with combustibles in too close proximity) are the most probable causes for fires involving electric water heaters. In general, however, electric water heaters do not pose the fire hazard that one would expect from a heat generating device rated at many kilowatts of power.

About the Author
Mark Goodson, PE, is the principal in Mark E. Goodson PE, Consulting Engineers, of Denton, Texas. This firm specializes in electrical and mechanical failure analysis related to fires, electrical shock incidents, and machine and equipment failure. Mr. Goodson received the BSEE from Texas A&M in 1979, and then studied both fire investigation and forensic medicine. Mr. Goodson is the engineering consultant for many medical examiner's offices in the state of Texas, and his firm has provided services to national, state, and local investigative agencies in regards to fire investigations.



(Readers Comments continued from Page 11)

**I AM COMPELLED TO COMPLIMENT
INVESTIGATOR BARRETT ON THE
SUCCESS OF HIS ENDEAVORS**

I have read with great interest the passionate responses to Investigator Bill Barrett's comments concerning NFPA 921 Proposal 114 (12-2.4) and Proposal 6 (1-2). Having done so I am compelled to compliment Investigator Barrett on the success of his endeavors.

Investigators Barrett's comments were clearly meant to stimulate, if not provoke, members of the fire investigation community into learning about and participating in the NFPA 921 publication process. I know this because Investigator Barrett requested my input on his comments prior to his submitting them for publication in the *Fire Trailer*. His comments and concerns in fact spurred me to review the Report on Proposals and to submit 16 separate Comments on Proposals reported out of the Technical Committee.

With regard to the critical and vindictive responses from Mr. Daniel Churchward and Mr. John Lentini, I believe they both missed the forest for the trees in their reading of Barrett's comments. I make no secret of the fact that Bill Barrett is a trusted friend and colleague, and a true gentleman. Anne who has worked with Bill will attest to his impeccable character and commendatory work ethic. I know of no one in the field of fire investigation who works harder at seeking the truth. Suffice it to say Bill leveled no personal attacks in his com-

ments although it is clear he struck a nerve among some members of the Technical Committee.

My reading of Barrett's comments on the issue of "Negative Corpus" indicated to me a concern that the Committee was preparing to publish language that could (and most certainly would) be used to seriously undermine many sound criminal investigations wherein the perpetrator simply walked away from the fire scene with the ignition source in hand. The wording of the Proposal negated the value of circumstantial evidence in determining the cause of a fire and essentially eliminated the need for judge or jury to weigh such evidence. And, judging from Mr. Lentini's self-congratulatory report on the Committee's subsequent actions on this Proposal, it appears he and other Committee members shared Barrett's concerns.

And Barrett's comments on the issue of "Consensus" speak not only to the process by which the NFPA 921 document is constructed, which is the apparent interpretation of both Churchward and Lentini. Rather, Barrett was also commenting on those "professional" fire investigators who would experience the irresistible urge to use such language to bolster their opinions and the document itself. If one accepts the definition of "consensus" to be a collective opinion, then NFPA 921 is definitely the consensus opinion of the Technical Committee. Likewise, if the document is approved by vote of the NFPA members in attendance

at the Fall 2000 Meeting, it can be argued that the document is the "consensus" of those members all 300 (or so) of them. However, when a learned "professional" attempts to bolster his or the document's authority by asserting that NFPA 921 is backed by the "full force and weight of the 66,000 members of the NFPA," I call that "a deliberate deception perpetrated for unfair gain," or a "fraud" as defined in *Webster's II New Riverside Dictionary*.

Finally, I am compelled to comment that neither Mr. Churchward's nor Mr. Lentini's responses to Investigator Barrett's comments do anything to allay the commonly held opinion of many public sector fire investigators that a high level of animosity against them exists within certain sections of the Technical Committee. I am weary of hearing such members impugn the professionalism of fire investigators who disagree with their agendas by constantly associating them with the old wives' tales of spalling, crazing and annealing. Likewise, the characterization of a fire investigator who publicly questions the actions of the Technical Committee or its members as "those who would have no standards" clearly reveals the self-righteous attitude of at least one Committee member. And, I am sure there are many fire investigators who are relieved to know they have John J. Lentini acting as chief negotiator and problem solver between the "ACLU types" and "jack-booted thugs" "camps" of the Committee.

*William Grom C.F.I.
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Item 2

**Discussion of storm drain pipe sizing
conversion chart from gallons per minute to
square footage from Kamm Consulting**

CHAPTER 11

STORM DRAINAGE

SECTION 1101 GENERAL

1101.1 Scope. The provisions of this chapter shall govern the materials, design, construction and installation of storm drainage.

1101.2 Disposal. Rainwater from roofs and storm water from paved areas, yards, courts and courtyards shall drain to an *approved* place of disposal. For one- and two-family dwellings, and where *approved*, storm water is permitted to discharge onto flat areas, such as streets or lawns, provided that the storm water flows away from the building.

1101.3 Prohibited drainage. Storm water shall not be drained into *sewers* intended for sewage only.

1101.4 Tests. The conductors and the building *storm drain* shall be tested in accordance with Section 312.

1101.5 Change in size. The size of a drainage pipe shall not be reduced in the direction of flow.

1101.6 Fittings and connections. All connections and changes in direction of the storm drainage system shall be made with *approved* drainage-type fittings in accordance with Table 706.3. The fittings shall not obstruct or retard flow in the system.

1101.7 Roof design. Roofs shall be designed for the maximum possible depth of water that will pond thereon as determined by the relative levels of roof deck and overflow weirs, scuppers, edges or serviceable drains in combination with the deflected structural elements. In determining the maximum possible depth of water, all primary roof drainage means shall be assumed to be blocked. The maximum possible depth of water on the roof shall include the height of the water required above the inlet of the secondary roof drainage means to achieve the required flow rate of the secondary drainage means to accommodate the design rainfall rate as required by Section 1106.

1101.8 Cleanouts required. Cleanouts shall be installed in the storm drainage system and shall comply with the provisions of this code for sanitary drainage pipe cleanouts.

Exception: Subsurface drainage system.

1101.9 Backwater valves. Storm drainage systems shall be provided with backwater valves as required for sanitary drainage systems in accordance with Section 715.

SECTION 1102 MATERIALS

1102.1 General. The materials and methods utilized for the construction and installation of storm drainage systems shall comply with this section and the applicable provisions of Chapter 7.

1102.2 Inside storm drainage conductors. Inside storm drainage conductors installed above ground shall conform to one of the standards listed in Table 702.1.

1102.3 Underground building storm drain pipe. Underground building *storm drain* pipe shall conform to one of the standards listed in Table 702.2.

1102.4 Building storm sewer pipe. Building storm *sewer* pipe shall conform to one of the standards listed in Table 1102.4.

**TABLE 1102.4
BUILDING STORM SEWER PIPE**

MATERIAL	STANDARD
Acrylonitrile butadiene styrene (ABS) plastic pipe	ASTM D2661; ASTM D2751; ASTM F628; CSA B181.1; CSA B182.1
Cast-iron pipe	ASTM A74; ASTM A888; CISPI 301
Concrete pipe	ASTM C14; ASTM C76; CSA A257.1M; CSA A257.2M
Copper or copper-alloy tubing (Type K, L, M or DWV)	ASTM B75; ASTM B88; ASTM B251; ASTM B306
Polyethylene (PE) plastic pipe	ASTM F2306/F2306M
Polyvinyl chloride (PVC) plastic pipe (Type DWV, SDR26, SDR35, SDR41, PS50 or PS100)	ASTM D2665; ASTM D3034; ASTM F891; CSA B182.4; CSA B181.2; CSA B182.2
Vitrified clay pipe	ASTM C4; ASTM C700
Stainless steel drainage systems, Type 316L	ASME A112.3.1

1102.5 Subsoil drain pipe. Subsoil drains shall be open-jointed, horizontally split or perforated pipe conforming to one of the standards listed in Table 1102.5.

**TABLE 1102.5
SUBSOIL DRAIN PIPE**

MATERIAL	STANDARD
Cast-iron pipe	ASTM A74; ASTM A888; CISPI 301
Polyethylene (PE) plastic pipe	ASTM F405; CSA B182.1; CSA B182.6; CSA B182.8
Polyvinyl chloride (PVC) Plastic pipe (type sewer pipe, SDR35, PS25, PS50 or PS100)	ASTM D2729; ASTM D3034, ASTM F891; CSA B182.2; CSA B182.4
Stainless steel drainage systems, Type 316L	ASME A 112.3.1
Vitrified clay pipe	ASTM C4; ASTM C700

STORM DRAINAGE

1102.6 Roof Drains. Roof drains shall conform to ASME A112.6.4 or ASME A112.3.1.

1102.7 Fittings. Pipe fittings shall be *approved* for installation with the piping material installed, and shall conform to the respective pipe standards or one of the standards listed in Table 1102.7. The fittings shall not have ledges, shoulders or reductions capable of retarding or obstructing flow in the piping. Threaded drainage pipe fittings shall be of the recessed drainage type.

**TABLE 1102.7
PIPE FITTING**

MATERIAL	STANDARD
Acrylonitrile butadiene styrene (ABS) plastic	ASTM D2661; ASTM D3311; CSA B181.1
Cast-iron	ASME B16.4; ASME B16.12; ASTM A888; CISPI 301; ASTM A74
Coextruded composite ABS and drain DR-PS in PS35, PS50, PS100, PS140, PS200	ASTM D2751
Coextruded composite ABS DWV Schedule 40 IPS pipe (solid or cellular core)	ASTM D2661; ASTM D3311; ASTM F628
Coextruded composite PVC DWV Schedule 40 IPS-DR, PS140, PS200 (solid or cellular core)	ASTM D2665; ASTM D3311; ASTM F891
Coextruded composite PVC sewer and drain DR-PS in PS35, PS50, PS100, PS140, PS200	ASTM D3034
Copper or copper alloy	ASME B16.15; ASME B16.18; ASME B16.22; ASME B16.23; ASME B16.26; ASME B16.29
Gray iron and ductile iron	AWWA C110/A21.10
Malleable iron	ASME B16.3
Plastic, general	ASTM F409
Polyethylene (PE) plastic pipe	ASTM F2306/F2306M
Polyvinyl chloride (PVC) plastic	ASTM D2665; ASTM D3311; ASTM F1866
Steel	ASME B16.9; ASME B16.11; ASME B16.28
Stainless steel drainage systems, Type 316L	ASME A112.3.1

**SECTION 1103
TRAPS**

1103.1 Main trap. Leaders and *storm drains* connected to a combined sewer shall be trapped. Individual storm water traps shall be installed on the storm water drain *branch* serving each conductor, or a single trap shall be installed in the main *storm drain* just before its connection with the combined *building sewer* or the *public sewer*. Leaders and storm drains connected to a building storm sewer shall not be required to be trapped.

1103.2 Material. Storm water traps shall be of the same material as the piping system to which they are attached.

1103.3 Size. Traps for individual conductors shall be the same size as the horizontal drain to which they are connected.

1103.4 Cleanout. An accessible cleanout shall be installed on the building side of the trap.

**SECTION 1104
CONDUCTORS AND CONNECTIONS**

1104.1 Prohibited use. Conductor pipes shall not be used as soil, waste or vent pipes, and soil, waste or vent pipes shall not be used as conductors.

1104.2 Floor drains. Floor drains shall not be connected to a *storm drain*.

**SECTION 1105
ROOF DRAINS**

1105.1 General. Roof drains shall be installed in accordance with the manufacturer's instructions. The inside opening for the roof drain shall not be obstructed by the roofing membrane material.

1105.2 Roof drain flow rate. The published roof drain flow rate, based on the head of water above the roof drain, shall be used to size the storm drainage system in accordance with Section 1106. The flow rate used for sizing the storm drainage piping shall be based on the maximum anticipated ponding at the roof drain.

**SECTION 1106
SIZE OF CONDUCTORS, LEADERS
AND STORM DRAINS**

1106.1 General. The size of the vertical conductors and leaders, building *storm drains*, building storm *sewers* and any horizontal branches of such drains or *sewers* shall be based on the 100-year hourly rainfall rate indicated in Figure 1106.1 or on other rainfall rates determined from *approved* local weather data.

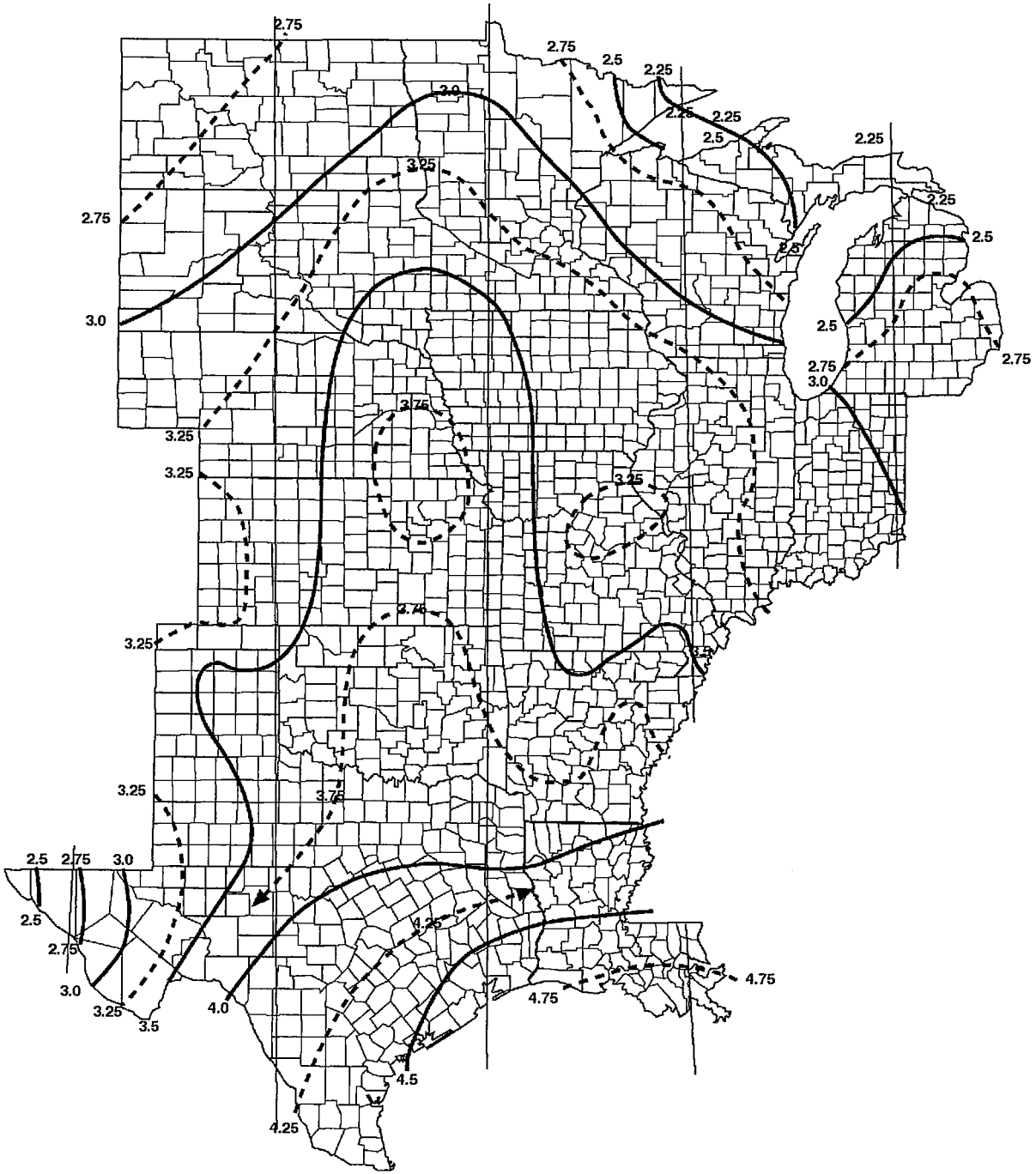


For SI: 1 inch = 25.4 mm.

Source: National Weather Service, National Oceanic and Atmospheric Administration, Washington D.C.

FIGURE 1106.1
100-YEAR, 1-HOUR RAINFALL (INCHES) EASTERN UNITED STATES

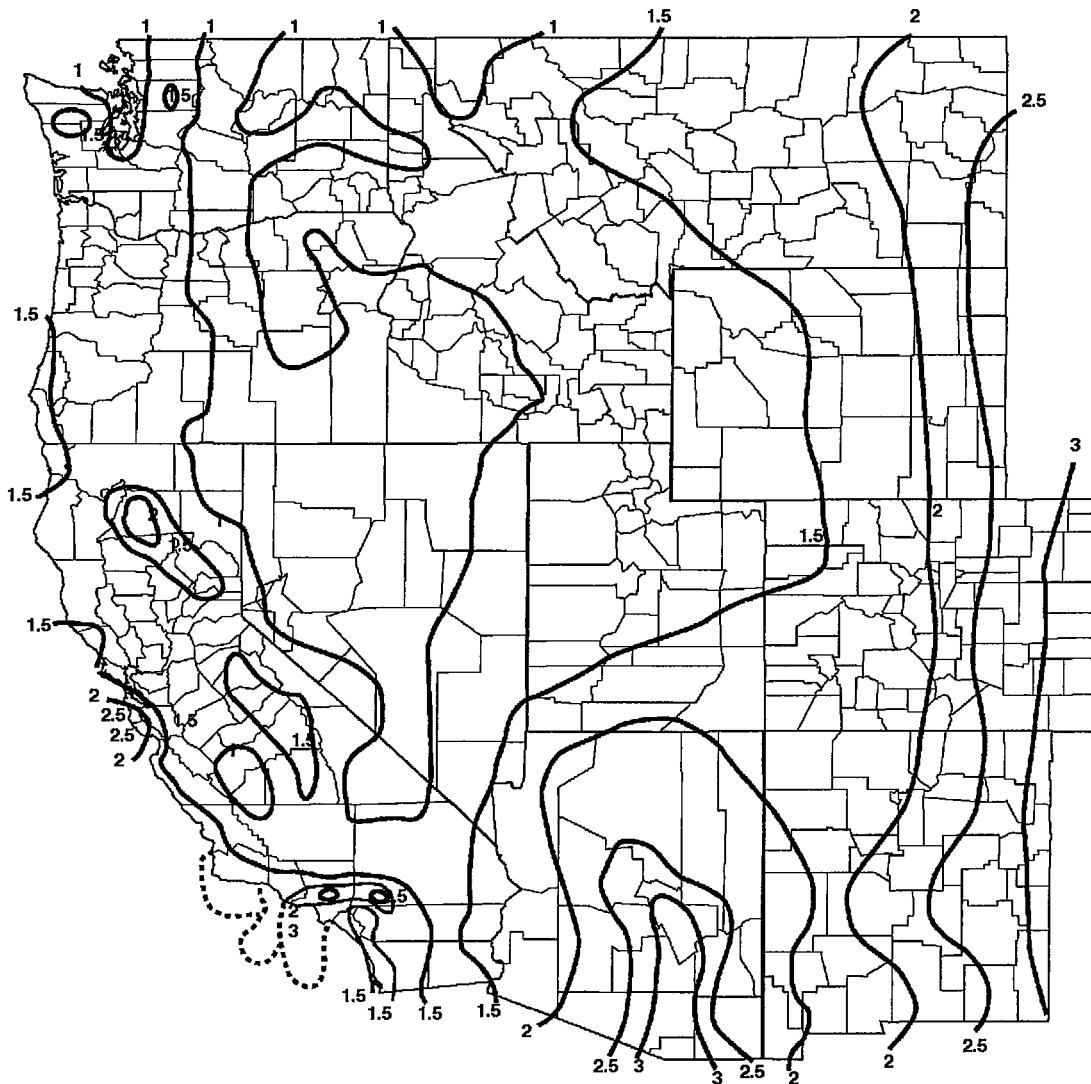
STORM DRAINAGE



For SI: 1 inch = 25.4 mm.

Source: National Weather Service, National Oceanic and Atmospheric Administration, Washington D.C.

FIGURE 1106.1—continued
100-YEAR, 1-HOUR RAINFALL (INCHES) CENTRAL UNITED STATES

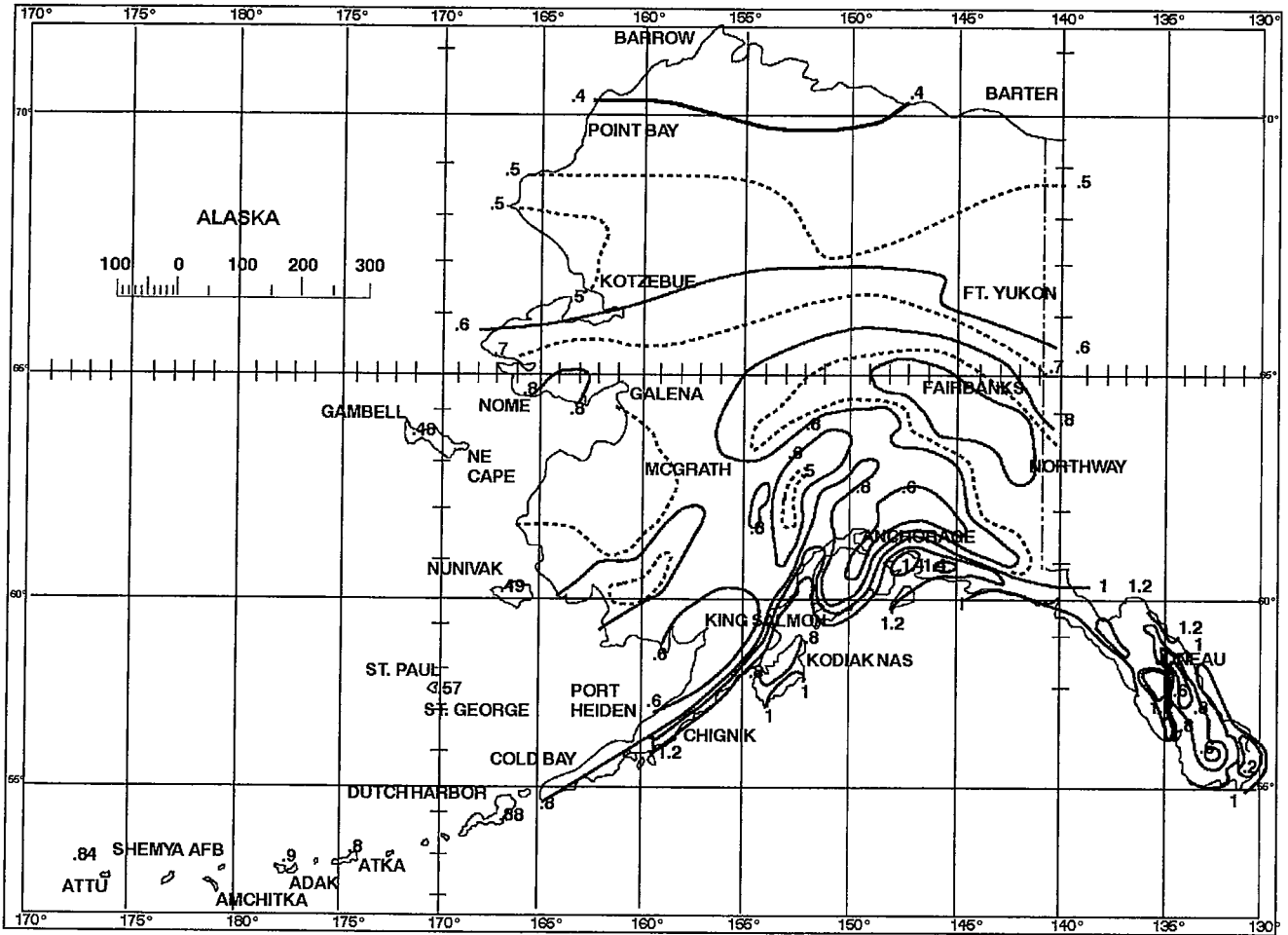


For SI: 1 inch = 25.4 mm.

Source: National Weather Service, National Oceanic and Atmospheric Administration, Washington D.C.

FIGURE 1106.1—continued
100-YEAR, 1-HOUR RAINFALL (INCHES) WESTERN UNITED STATES

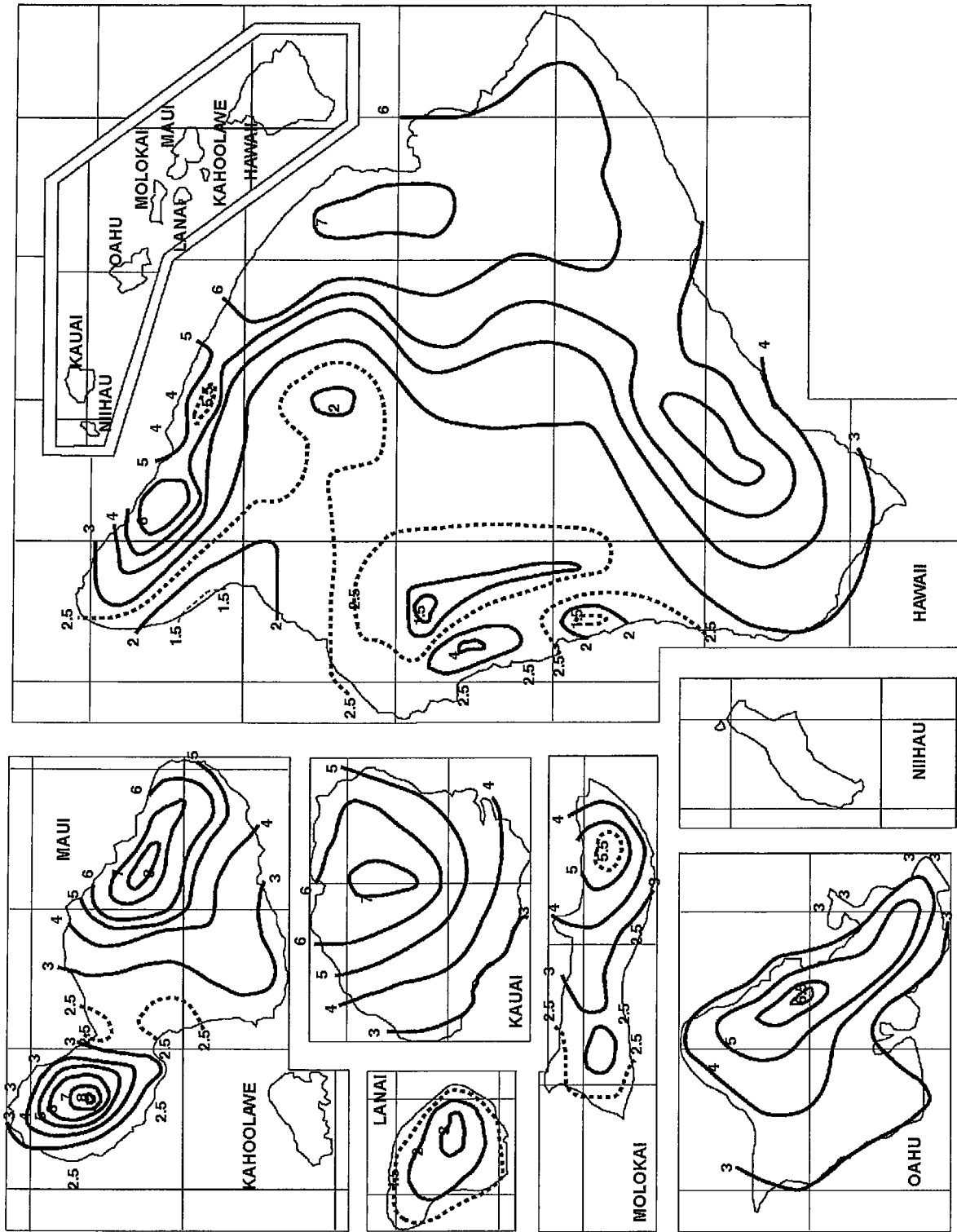
STORM DRAINAGE



For SI: 1 inch = 25.4 mm.

Source: National Weather Service, National Oceanic and Atmospheric Administration, Washington D.C.

FIGURE 1106.1—continued
100-YEAR, 1-HOUR RAINFALL (INCHES) ALASKA



For SI: 1 inch = 25.4 mm.

Source: National Weather Service, National Oceanic and Atmospheric Administration, Washington D.C.

FIGURE 1106.1—continued
100-YEAR, 1-HOUR RAINFALL (INCHES) HAWAII

STORM DRAINAGE

1106.2 Size of storm drain piping. Vertical and horizontal storm drain piping shall be sized based on the flow rate through the roof drain. The flow rate in storm drain piping shall not exceed that specified in Table 1106.2.

1106.3 Vertical leader sizing. Vertical leaders shall be sized based on the flow rate from horizontal gutters or the maximum flow rate through roof drains. The flow rate through vertical leaders shall not exceed that specified in Table 1106.3.

**TABLE 1106.3
VERTICAL LEADER SIZING**

SIZE OF LEADER (inches)	CAPACITY (gpm)
2	30
2 × 2	30
1½ × 2½	30
2½	54
2½ × 2½	54
3	92
2 × 4	92
2½ × 3	92
4	192
3 × 4¼	192
3½ × 4	192
5	360
4 × 5	360
4½ × 4½	360
6	563
5 × 6	563
5½ × 5½	563
8	1208
6 × 8	1208

For SI: 1 inch = 25.4 mm, 1 gallon per minute = 3.785 L/m.

1106.4 Vertical walls. In sizing roof drains and storm drainage piping, one-half of the area of any vertical wall that diverts rainwater to the roof shall be added to the projected roof area for inclusion in calculating the required size of vertical conductors, leaders and horizontal storm drainage piping.

1106.5 Parapet wall scupper location. Parapet wall roof drainage scupper and overflow scupper location shall comply with the requirements of Section 1503.4 of the *Florida Building Code, Building*.

1106.6 Size of roof gutters. Horizontal gutters shall be sized based on the flow rate from the roof surface. The flow rate in horizontal gutters shall not exceed that specified in Table 1106.6.

**SECTION 1107
SIPHONIC ROOF DRAINAGE SYSTEMS**

1107.1 General. Siphonic roof drains and drainage systems shall be designed in accordance with ASME A112.6.9 and ASPE 45.

**SECTION 1108
SECONDARY (EMERGENCY) ROOF DRAINS**

1108.1 Secondary (emergency overflow) drains or scuppers. Where roof drains are required, secondary (emergency overflow) roof drains or scuppers shall be provided where the roof perimeter construction extends above the roof in such a manner that water will be entrapped if the primary drains allow buildup for any reason. Where primary and secondary roof drains are manufactured as a single assembly, the inlet and outlet for each drain shall be independent.

1108.2 Separate systems required. Secondary roof drain systems shall have the end point of discharge separate from the primary system. Discharge shall be above grade, in a location that would normally be observed by the building occupants or maintenance personnel.

**TABLE 1106.2
STORM DRAIN PIPE SIZING**

PIPE SIZE (inches)	CAPACITY (gpm)				
	VERTICAL DRAIN	SLOPE OF HORIZONTAL DRAIN			
		1/16 inch per foot	1/8 inch per foot	1/4 inch per foot	1/2 inch per foot
2	34	15	22	31	44
3	87	39	55	79	111
4	180	81	115	163	231
5	311	117	165	234	331
6	538	243	344	487	689
8	1,117	505	714	1,010	1,429
10	2,050	927	1,311	1,855	2,623
12	3,272	1,480	2,093	2,960	4,187
15	5,543	2,508	3,546	5,016	7,093

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 gallon per minute = 3.785 L/m.

1108.3 Sizing of secondary drains. Secondary (emergency) roof drain systems shall be sized in accordance with Section 1106 based on the rainfall rate for which the primary system is sized. Scuppers shall be sized to prevent the depth of ponding water from exceeding that for which the roof was designed as determined by Section 1101.7. Scuppers shall have an opening dimension of not less than 4 inches (102 mm). The flow through the primary system shall not be considered when sizing the secondary roof drain system.

**SECTION 1109
COMBINED SANITARY AND
STORM PUBLIC SEWER**

1109.1 General. Where the public sewer is a combined system for both sanitary and storm water, the storm sewer shall be connected independently to the public sewer.

**SECTION 1110
CONTROLLED FLOW ROOF DRAIN SYSTEMS**

1110.1 General. The roof of a structure shall be designed for the storage of water where the storm drainage system is engineered for controlled flow. The controlled flow roof drain system shall be an engineered system in accordance with this section and the design, submittal, approval, inspection and testing requirements of Section 316.1. The controlled flow

system shall be designed based on the required rainfall rate in accordance with Section 1106.1.

1110.2 Control devices. The control devices shall be installed so that the rate of discharge of water per minute shall not exceed the values for continuous flow as indicated in Section 1110.1.

1110.3 Installation. Runoff control shall be by control devices. Control devices shall be protected by strainers.

1110.4 Minimum number of roof drains. Not less than two roof drains shall be installed in roof areas 10,000 square feet (929 m²) or less and not less than four roof drains shall be installed in roofs over 10,000 square feet (929 m²) in area.

**SECTION 1111
SUBSOIL DRAINS**

1111.1 Subsoil drains. Subsoil drains shall be open-jointed, horizontally split or perforated pipe conforming to one of the standards listed in Table 1102.5. Such drains shall not be less than 4 inches (102 mm) in diameter. Where the building is subject to backwater, the subsoil drain shall be protected by an accessibly located backwater valve. Subsoil drains shall discharge to a trapped area drain, sump, dry well or *approved* location above ground. The subsoil sump shall not be required to have either a gas-tight cover or a vent. The sump and pumping system shall comply with Section 1113.1.

**TABLE 1106.6
HORIZONTAL GUTTER SIZING**

GUTTER DIMENSIONS ^a (inches)	SLOPE (inch per foot)	CAPACITY (gpm)
1½ × 2½	¼	26
1½ × 2½	½	40
4	⅛	39
2¼ × 3	¼	55
2¼ × 3	½	87
5	⅛	74
4 × 2½	¼	106
3 × 3½	½	156
6	⅛	110
3 × 5	¼	157
3 × 5	½	225
8	⅛	172
8	¼	247
4½ × 6	¼	348
4½ × 6	½	494
10	⅛	331
10	¼	472
5 × 8	¼	651
4 × 10	½	1055

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 gallon per minute = 3.785 L/m, 1 inch per foot = 83.3 mm/m.

a. Dimensions are width by depth for rectangular shapes. Single dimensions are diameters of a semicircle.

**SECTION 1112
BUILDING SUBDRAINS**

1112.1 Building subdrains. *Building subdrains* located below the *public sewer* level shall discharge into a sump or receiving tank, the contents of which shall be automatically lifted and discharged into the drainage system as required for building sumps. The sump and pumping equipment shall comply with Section 1113.1.

**SECTION 1113
SUMPS AND PUMPING SYSTEMS**

1113.1 Pumping system. The sump pump, pit and discharge piping shall conform to Sections 1113.1.1 through 1113.1.4.

1113.1.1 Pump capacity and head. The sump pump shall be of a capacity and head appropriate to anticipated use requirements.

1113.1.2 Sump pit. The sump pit shall be not less than 18 inches (457 mm) in diameter and not less than 24 inches (610 mm) in depth, unless otherwise *approved*. The pit shall be accessible and located such that all drainage flows into the pit by gravity. The sump pit shall be constructed of tile, steel, plastic, cast iron, concrete or other *approved* material, with a removable cover adequate to support anticipated loads in the area of use. The pit floor shall be solid and provide permanent support for the pump.

1113.1.3 Electrical. Electrical service outlets, when required, shall meet the requirements of NFPA 70.

1113.1.4 Piping. Discharge piping shall meet the requirements of Section 1102.2, 1102.3 or 1102.4 and shall include a gate valve and a full flow check valve. Pipe and fittings shall be the same size as, or larger than, the pump discharge tapping.

Exception: In one- and two-family dwellings, only a check valve shall be required, located on the discharge piping from the pump or ejector.



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**TABLE 1106.2 – BROWARD
 STORM DRAIN PIPE SIZING**

PIPE SIZE (inches)		CAPACITY (sq. ft. @ 5" per hour rainfall)			
		SLOPE OF HORIZONTAL DRAIN			
VERTICAL DRAIN		1/16 inch per foot	1/8 inch per foot	1/4 inch per foot	1/4 inch per foot
2	654	288	423	596	846
3	1,673	750	1,058	1,519	2,134
4	3,461	1,557	2,212	3,134	4,442
5	5,980	2,250	3,173	4,500	6,365
6	10,346	4,673	6,615	9,365	13,250
8	21,480	9,711	13,730	19,423	27,480
10	39,423	17,827	25,212	35,673	50,442
12	62,923	28,461	40,250	56,923	80,519
15	106,596	48,230	68,192	96,461	136,404

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**TABLE 1106.3 – BROWARD
 VERTICAL LEADER SIZING**

SIZE OF LEADER (inches)	CAPACITY (sq. ft. @ 5" per hour rainfall)
2	577
2 x 2	577
1 ½ x 2 ½	577
2 ½	1,038
2 ½ x 2 ½	1,038
3	1,769
2 x 4	1,769
2 ½ x 3	1,769
4	3,692
3 x 4 ¼	3,692
3 ½ x 4	3,692
5	6,923
4 x 5	6,923
4 ½ x 4 ½	6,923
6	10,827
5 x 6	10,827
5 ½ x 5 ½	10,827
8	23,231
6 x 8	23,231

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**TABLE 1106.6 – BROWARD
HORIZONTAL GUTTER SIZING**

GUTTER DIMENSIONS (inches)	SLOPE (inch per foot)	CAPACITY (sq. ft. @ 5" per hour rainfall)
1 1/2 x 2 1/2	1/4	500
1 1/2 x 2 1/2	1/2	769
4	1/8	750
2 1/4 x 3	1/4	1,058
2 1/4 x 3	1/2	1,673
5	1/8	1,423
4 x 2 1/2	1/4	2,038
3 x 3 1/2	1/2	3,000
6	1/8	2,115
3 x 5	1/4	3,019
3 x 5	1/2	4,327
8	1/16	3,308
8	1/8	4,750
4 1/2 x 6	1/4	6,692
4 1/2 x 6	1/2	9,500
10	1/16	6,365
10	1/8	9,077
5 x 8	1/4	12,519
4 x 10	1/2	20,288

*Dimensions are width by depth for rectangular shapes. Single dimensions are diameters of a semicircle.

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set forth in the Broward County Amendments to the FFPC, 6th Edition.

~~104.23.1 To be recertified, all Fire Marshal/Fire Code Officials, Fire Plans Examiners, Fire Inspectors or a combination thereof who are presently certified by BORA, shall meet the following criteria:~~

~~104.23.1.1 Be presently employed by a governmental fire entity within Broward County.~~

~~104.23.1.2 Recertification shall have the same anniversary date as provided in Florida Statutes, Chapter 633, with the completion of sixty (60) contact hours in continuing education every four (4) consecutive years on Fire Protection and Fire Safety, which are approved by BORA. Attendance at BORA meetings and/or BORA committee meetings shall be counted as one (1) hour for a maximum of fifteen (15) county required contact hours within a four (4) year renewal period.~~

~~104.23.1.3 Personnel assigned to the bureau as Fire Inspectors shall be State of Florida Certified Firefighters (see 18-month exception), State of Florida Certified Fire Inspectors. For certification refer to Florida State Statute 633. Individuals being considered for appointment shall be required to complete an affidavit of compliance with 71-575 (see BORA Policy 14-02).~~

~~104.23.2 If certification is not renewed and allowed to lapse, application for recertification shall be accompanied with proof that fifteen (15) contact hours per year, under the preceding 4 years in continuing education has been met. If the certification is not renewed within 8 years the individual must retake the state fire safety inspector's training and take the local fire exam, and shall be on a form containing such pertinent information as is considered relevant to BORA.~~

~~104.23.3 Recertification Fee: If applicable, each application shall be accompanied by a check in the amount appropriate for each discipline according to BORA Fee Schedule for Recertification, payable to "Broward County Board of County Commissioners."~~

104.24 Applications and permits. Reserved. See Section 105.

104.25 Notices and Orders. The Building Official or his or her duly authorized representative and/or Fire Marshal/Fire Code Official or his or her duly authorized representative shall issue all necessary notices or orders to ensure compliance with this Code, the Fire Protection Provisions of this Code, FFPC, and all Fire Codes.

104.25.1 Concealed Work: The Building Official or his or her duly authorized representative and/or Fire Marshal/Fire Code Official or his or her duly authorized representative may order portions of the structural frame of a building and/or structure to be exposed for inspection when, in his or her opinion, there is a good reason to believe that a

building or portion thereof is in an unsafe or dangerous condition or that there is willful or negligent concealment of a violation of this Code, the Fire Protection Provisions of this Code, FFPC, and all Fire Codes.

104.26 Inspections. Reserved. See Section 110.

104.27 Identification. Reserved.

104.28 Right of Entry. Upon presentation of proper credentials, the Building Official or his or her duly authorized representative or the Fire Chief/Fire Marshal/Fire Code Official or his or her duly authorized representative may enter, at any reasonable time, any building, structure or premises for the purpose of making any inspection or investigation, which falls under the provisions of this Code, and FFPC.

104.29 Department records. Reserved.

104.30 Liability. Reserved.

104.31 Modifications. Reserved.

*** 104.32 Alternative materials, design and methods of construction and equipment.** The provisions of the technical codes are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this Code, provided any such alternative has been reviewed and approved by the Building Official and/or Fire Marshal/Fire Code Official (according to the Fire Protection Provisions of this Code and FFPC). An alternative material, design or method of construction shall be approved where the Building Official and/or Fire Marshal/Fire Code Official (according to the Fire Protection Provisions of this Code and FFPC) finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method of construction offered for the purpose intended; is at least the equivalent of that prescribed in the technical codes in quality, strength, effectiveness, fire resistance, durability and safety. Where alternate life safety systems are designed, the "SFPE Engineering Guide to Performance-Based Fire Protection Analysis and Design of Buildings," or other methods approved by the Building Official and/or Fire Marshal/Fire Code Official (according to the Fire Protection Provisions of this Code and FFPC) may be used. The Building Official and/or Fire Marshal/Fire Code official (according to the Fire Protection Provisions of this Code and FFPC) shall require that sufficient evidence or proof be submitted to substantiate any claim made regarding the alternative. Where the alternative material, design or method of construction is not approved, the building official shall respond in writing, stating the reasons why the alternative was not approved.

104.32.1 Research reports. Supporting data, where necessary to assist in the approval of materials or assemblies not specifically provided for in this Code, shall consist of valid research reports from approved sources.

ROOF DRAINS



SIZING DATA (For Conventional Drainage)

Zurn makes it easy to size roof drains. The four things you will need to know are: 1) rate of precipitation; 2) total area of roof; 3) size of leader required; and 4) area handled by each drain.

When sizing roof drains, the limiting factor for the amount of water each drain will carry away is the size of leader. Therefore, increasing leader size decreases the number of drains required.

STEP-BY-STEP SIZING OF ZURN DRAINS

Step 1: A. Calculate total roof area.

Example: Roof area is 300 x 500 ft; 300 x 500 = 150,000 sq. ft.

B. Determine the size of leader to be used.

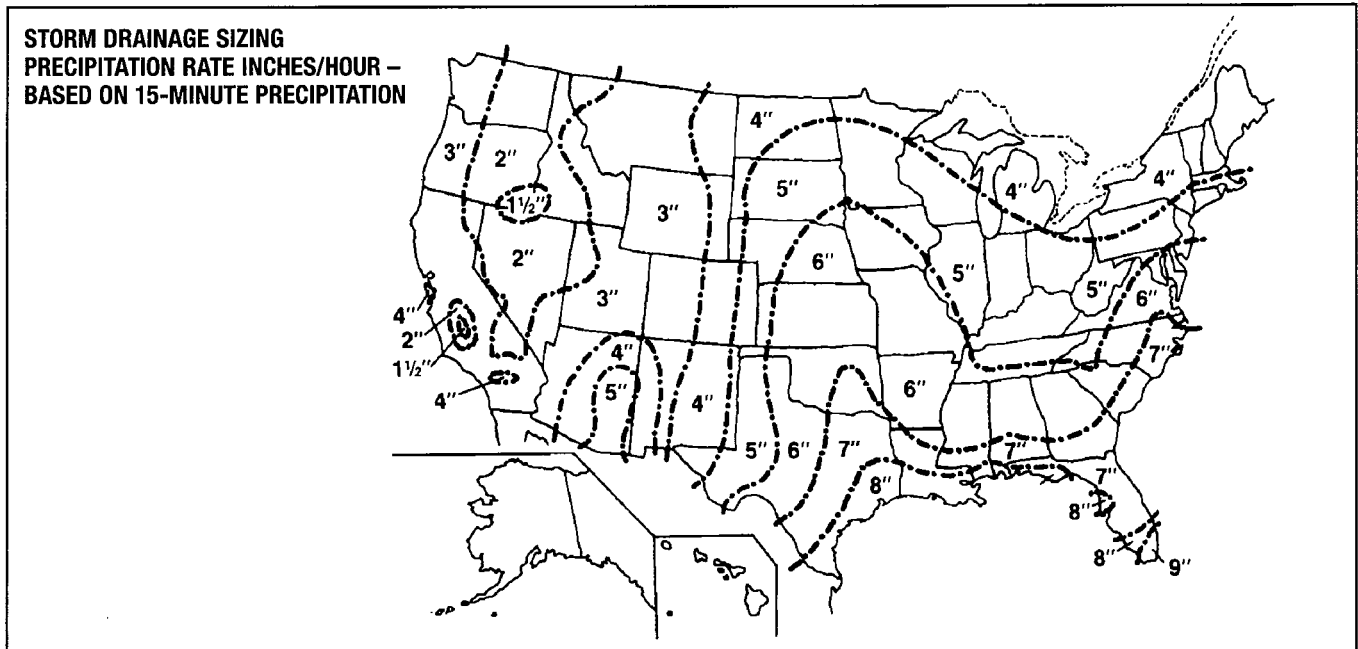
Example: 4" leader size is selected.

Step 2: Locate building site on map below to find rainfall rate.

Note: This map is taken from the National Standard Plumbing Code, Appendix A, and should only be used for general reference. Consult local codes for more precise data. **Example:** For a building located in Erie, PA, the map shows a 4" hourly rainfall.

Step 3: Cross reference leader size with hourly rainfall in chart below to obtain roof area that can be handled by each leader. **Example:** For a 4" hourly rainfall and 4" leader, each drain can handle 4,600 sq. ft. of roof area.

Step 4: Divide total roof area by area found in Step 3 to obtain the number of drains required. **Example:** 150,000 sq. ft. divided by the 4,600 sq. ft. equals 32.6, or 33 drains required. The drains should be equally spaced and located symmetrically about the roof.



ROOF DRAIN VERTICAL REQUIREMENT FOR HORIZONTAL ROOF AREAS AT VARIOUS RAINFALL RATES*											
Leader Size		Hourly Rainfall In Inches									
Pipe Size (Inches)	Open Area (Sq. In.)	1	1-1/2	2	2-1/2	3	4	5	6	7	8
		Total Square Footage Covered Per Drain									
2	3.14	2,880	1,920	1,440	1,150	960	720	575	480	410	360
3	7.06	8,880	5,860	4,400	3,520	2,930	2,200	1,760	1,470	1,260	1,100
4	12.56	18,400	12,700	9,200	7,360	6,130	4,600	3,680	3,070	2,630	2,300
5	19.60	34,600	23,050	17,300	13,840	11,530	8,650	6,920	5,765	4,945	4,325
6	28.30	54,000	36,000	27,000	21,600	18,000	13,500	10,800	9,000	7,715	6,750
8	50.25	116,000	77,400	58,000	46,400	38,660	29,000	23,200	19,315	16,570	14,500

*Above sizing data is offered as a guide only. For actual applications consult local codes.

ROOF DRAIN TECHNICAL DATA SECTION

DEFINITION - ORIGIN - USAGE

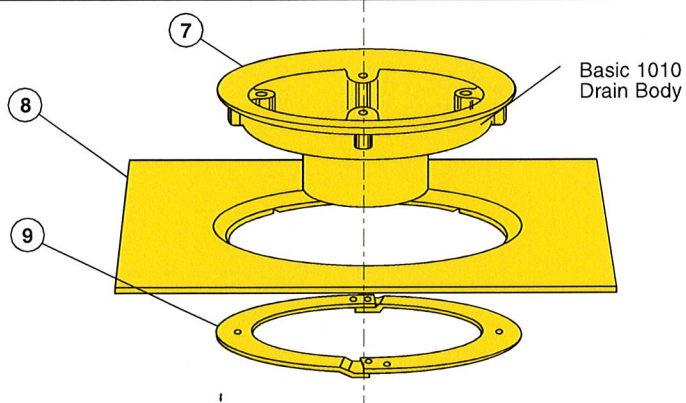
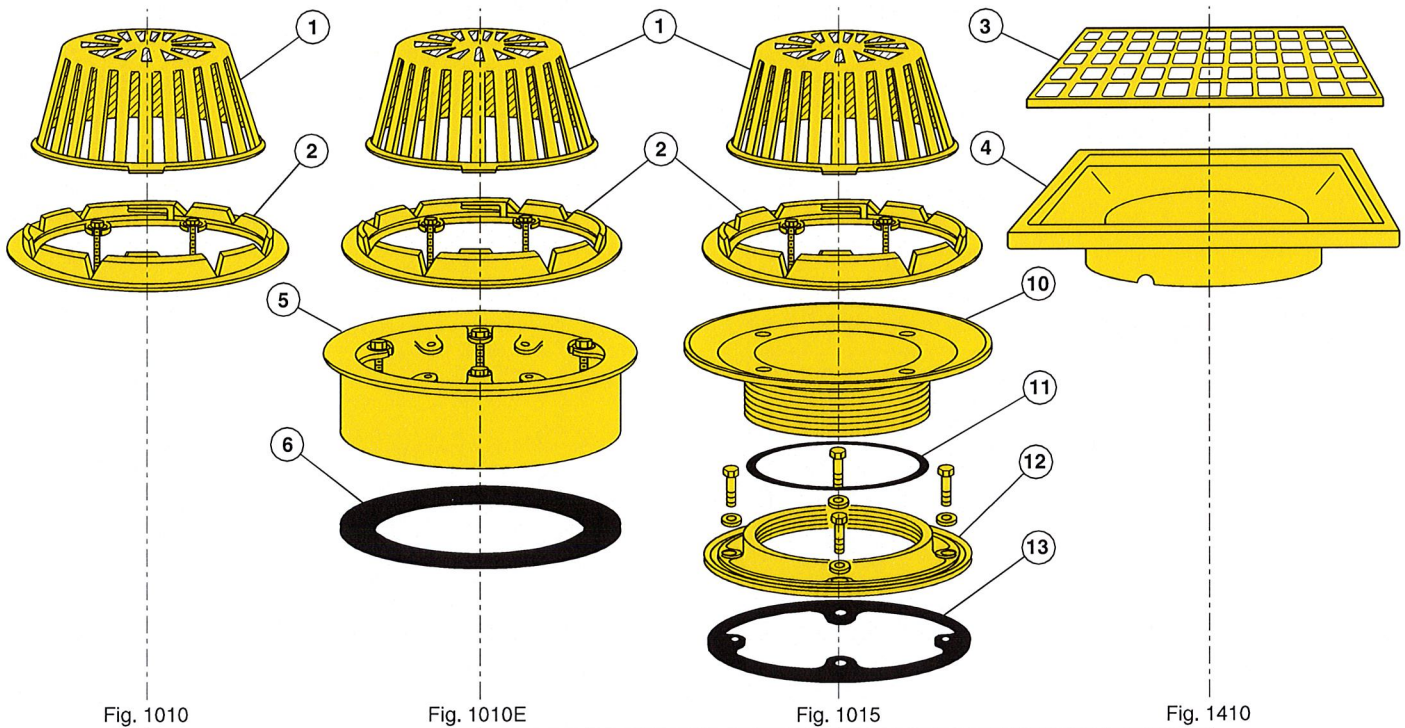
The modern roof drain is designed to drain off rainwater in the most effective manner possible while maintaining an aesthetic appeal because in many instances it is placed in full view of the public.

Through the years, Smith has attempted to satisfy both the artistic eye of the architect and the calculating mind of the engineer, concluding the properly designed roof drain must have the following features:

- Pleasing dome shape with a low profile and adequate free drainage area
- Corrosion-resisting dome material
- Effective debris protection
- Overflow drainage to allow drainage during debris build-up
- Gravel stop
- Positive Flashing Clamp
- Seepage control channels
- Sump designed to minimize air entrapment
- Flexibility to meet all construction requirements

Smith roof drains include all of these features.

TYPICAL SMITH ROOF DRAINS



ROOF DRAIN PARTS LIST

NO.	DESCRIPTION	NO.	DESCRIPTION
1	High Density Polyethylene Dome	7	Drain Body
2	Combined Cast Iron Flashing Clamp and Gravel Stop	8	Sump Receiver
3	Secured Square Hole Grate	9	Underdeck Clamp
4	Flashing Clamp for Square Grate	10	Adjustable Extension Sleeve
5	Fixed Extension	11	O-Ring Gasket
6	Fixed Extension Gasket	12	Reversible Collar
		13	Neoprene Gasket

SELECTING A ROOF DRAIN

To select the proper roof drain, the following information must be determined by the designer/specifier.

- Type of roof construction
- Roof pitch
- Maximum volume of expected rainfall and storm design criteria (This information must be obtained from your local weather bureau and/or local code authority)
- Desired rate of drainage
- Safety overflow requirements (Emergency/secondary overflow roof drains are recommended. Local codes vary but it is recommended to provide a 1 to 1 ratio)

- Roof load (The maximum possible rainwater [build-up] load should be determined and provided to the structural engineer for inclusion in the roof structure design)
- Location of drains (Consult your local code requirements)
- Size
- Vandal-proofing
- **NOTE: ALWAYS CONSULT YOUR LOCAL CODE FOR SIZING AND DESIGN CRITERIA WHEN DESIGNING THE ROOF DRAIN SYSTEM. LOCAL CODE REQUIREMENTS TAKE PRECEDENCE OVER CATALOG INFORMATION.**
- **DATA SHOWN IN TABLES 1 AND 2 BELOW ARE TAKEN FROM THE UNIFORM PLUMBING CODE (UPC) - 2006 EDITION.**

SUGGESTED STEPS FOR SELECTING PROPER ROOF DRAIN LEADER SIZES AND NUMBER REQUIRED FOR A GIVEN ROOF

	Example: Using a 4" Vertical Leader	Example: Using a 6" Vertical Leader
1. Calculate the total roof area.	1. Total roof area - 500' by 200' = 100,000 sq. ft.	1. Total roof area - 500' by 200' = 100,000 sq. ft.
2. Determine the maximum hourly rainfall in inches. (The figure can be acquired from your local weather bureau and/or local code authority.)	2. Determine rate of rainfall - for this example use 4".	2. Determine rate of rainfall - for this example use 4".
3. Select leader size.	3. After studying building plan and physical arrangement, assume that 4" leaders are required for this project.	3. After studying building plan and physical arrangement, assume that 6" leaders are required for this project.
4. From Table 1, determine the number of square feet that can be drained by one roof leader at the local maximum rainfall rate.	4. From Table 1 - one 4" leader at 4" rate of rainfall will take care of 3,460 sq. ft. of roof area.	4. From Table 1 - one 6" leader at 4" rate of rainfall will take care of 10,200 sq. ft. of roof area.
5. Divide the total roof area by the area that one leader will handle. The above result is the number of roof drains required for the building. If the result is a fraction less, use the next higher number.	5. Number of roof leaders required is 29 (100,000 sq. ft. divided by 3,460 sq. ft.), Therefore 29 roof drains would be required.	5. Number of roof leaders required is 10 (100,000 sq. ft. divided by 10,200 sq. ft.), Therefore 10 roof drains would be required.

**TABLE 1
ROOF DRAIN VERTICAL LEADER REQUIREMENTS FOR HORIZONTAL ROOF AREAS AT VARIOUS RAINFALL RATES**

Leaders [2] [4] Pipe Size Inches	Size Open Area SQ. In.	Maximum Allowable Horizontal Projected Roof Area Square Feet at Various Rainfall Rates [1]					
		1 IN./HR.	2 IN./HR.	3 IN./HR.	4 IN./HR.	5 IN./HR.	6 IN./HR.
02	3.14	2,176	1,088	725	544	435	363
03	7.06	6,440	3,220	2,147	1,610	1,288	1,073
04	12.56	13,840	6,920	4,613	3,460	2,768	2,307
05	19.60	25,120	12,560	8,373	6,280	5,024	4,187
06	28.30	40,800	20,400	13,600	10,200	8,160	6,800
08	50.25	88,000	44,000	29,333	22,000	17,600	14,667

TABLE 1 IS BASED ON TABLE 11-1 FROM THE UNIFORM PLUMBING CODE (UPC) - 2006 EDITION

[1] For rainfall rates other than those listed, determine the allowable roof area by dividing the area given in the 1 in./hr. column by the desired rainfall rate.

TABLE 2 ALLOWABLE FLOW FOR VERTICAL LEADERS AND HORIZONTAL STORM DRAINS ALLOWABLE FLOW IN G.P.M. [2] [3]				
PIPE SIZE	[2] [4] VERTICAL LEADER	HORIZONTAL STORM DRAIN SLOPE PER FOOT		
		1/8"[3]	1/4"[3]	1/2"[3]
02	23	10	15	20
03	67	34	48	68
04	144	78	110	156
05	261	139	196	278
06	424	222	314	445
08	913	478	677	956
10	—	860	1214	1721
12	—	1384	1953	2768
15	—	2473	3491	4946

TABLE 2 IS BASED ON TABLE 11-2 FROM THE UNIFORM PLUMBING CODE (UPC) - 2006 EDITION.

[2] The sizing data for vertical conductors, leaders, and drains are based on the pipes flowing 7/24 full. Head of water over drain will determine exact flow rates.

[3] The sizing for the horizontal piping is based on the pipes flowing full.

[4] To avoid severe hydraulic jump and/or backpressure, good engineering practice requires the vertical leader transition into a larger size horizontal storm drain per the GPM flow indicated in Table 2 for 1/8" and 1/4" sloped storm drains.

STEPS FOR CALCULATING DRAINAGE REQUIREMENTS FOR ABOVE EXAMPLE USING G.P.M.

1. Use the following formula to determine G.P.M.:
 $G.P.M. = .0104 \times R \times A$
 G.P.M. = Gallons per minute
 R = Rainfall intensity - inches/hour
 A = Roof area - square feet
 $.0104 = \text{Conversion factor} - G.P.M./\text{sq. ft. for } 1" \text{ (one) inch/hr. rainfall}$
2. **Example:**
 A. 4" rainfall inches/hr.
 B. 100,000 sq. ft. roof area
 C. $G.P.M. = .0104 \times 4" \times 100,000 \text{ sq. ft.} = 4,160 \text{ G.P.M.}$
3. Refer to table 2: a 4" leader [2] will handle 144 G.P.M.
 $4,160 \text{ G.P.M.} \div 144 = (28.8) \text{ } 29 - 4" \text{ vertical leaders required.}$

 Refer to Table 2: a 6" leader [2] will handle 424 G.P.M.
 $4,160 \text{ G.P.M.} \div 424 = (9.8) \text{ } 10 - 6" \text{ vertical leaders required.}$