ASHRAE PRESENTATION

Condensing Water Heaters for Domestic Applications

May 11/15

Outline

- Summary – Condensing Water Heaters
  - How they work
  - Features/Benefits
- Installations – Typical
  - Market Targets
  - Hydro Program

Outline (con’t)

- Design Issues
- Mechanical Room Designs
- Venting
- Concentric Vent
- Market Trends
- Payback Calculations

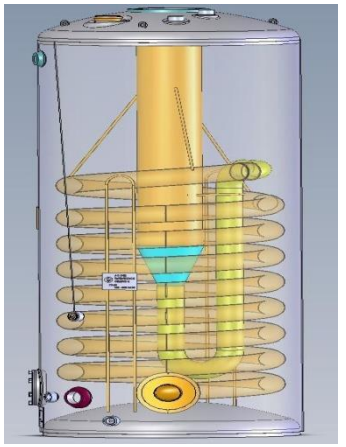
Condensing Water Heaters

http://university.hotwater.com/commercial/mxi/

Condensing Htr Product Details

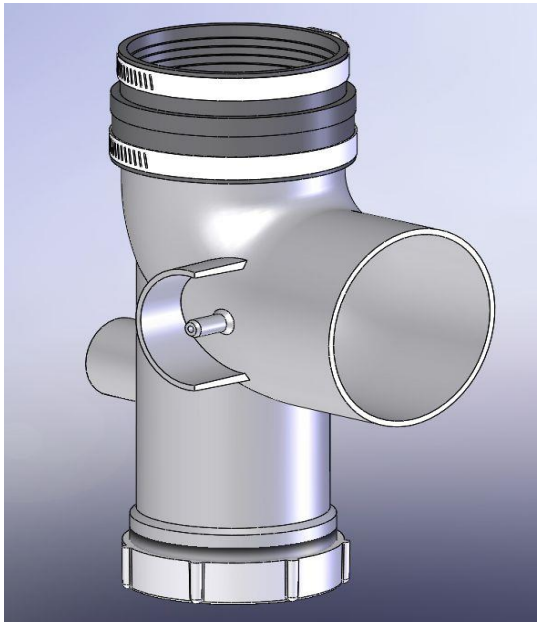
Tank Construction

- Exhaust/condensate relocated to front
- T&P relocated to left side
- Addition of recirculation loop return opening
- Larger diameter combustion tube
  - 150 – 250 was 5” now 6”
  - 300 – 500 was 8” now 10” (new 119 gal capacity)
- Fire tube cone transition
- Additional row of coil



Exhaust/Condensate Elbow

- Aluminum Condensate Elbow
  - Water trap
  - Debris trap and cleanout
  - Threaded port for condensate drain
  - Blocked outlet switch connection

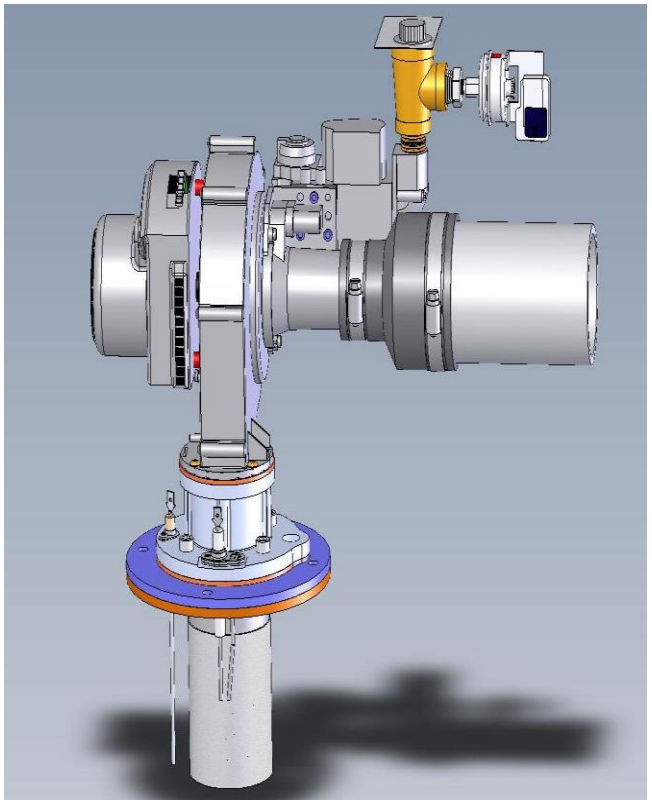


Top Components

- Enable/Disable switch
- Pressure switches vertically mounted
- Pressure switches grouped (from the front)
  - Blocked outlet with red label
  - Blocked inlet with aqua label
  - Blower prover with red label
- Spark ignition module
- New design control box
- Field wiring junction box

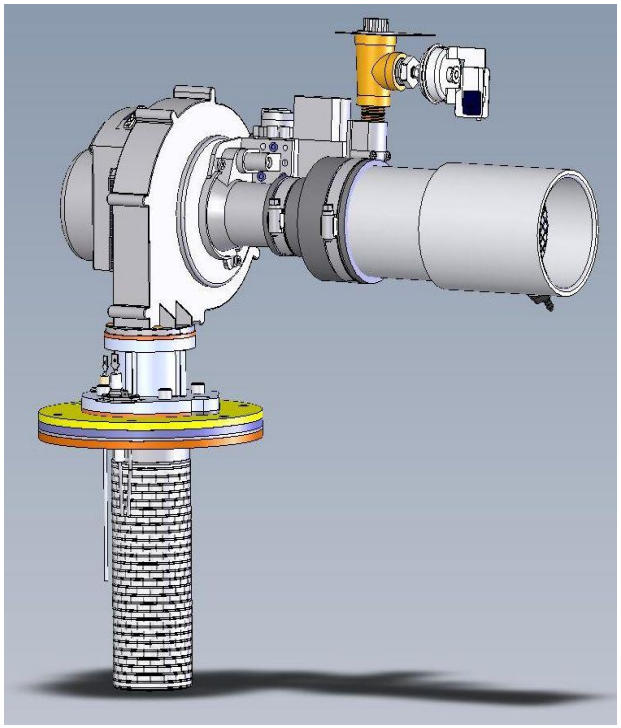
120 Model Combustion System

- Blower
- Natural Gas Valve/Venturi Assy with 053 Venturi
- LP Gas Valve/Venturi Assy with 003 Venturi
- Burner
- Spark Electrode
  - .125” Spark Gap (between spark rod and ground rod)
  - ¼” – 5/16” away from burner surface
- Flame Rod
  - ½” away from burner surface
- Aluminum Burner/Blower Adaptor



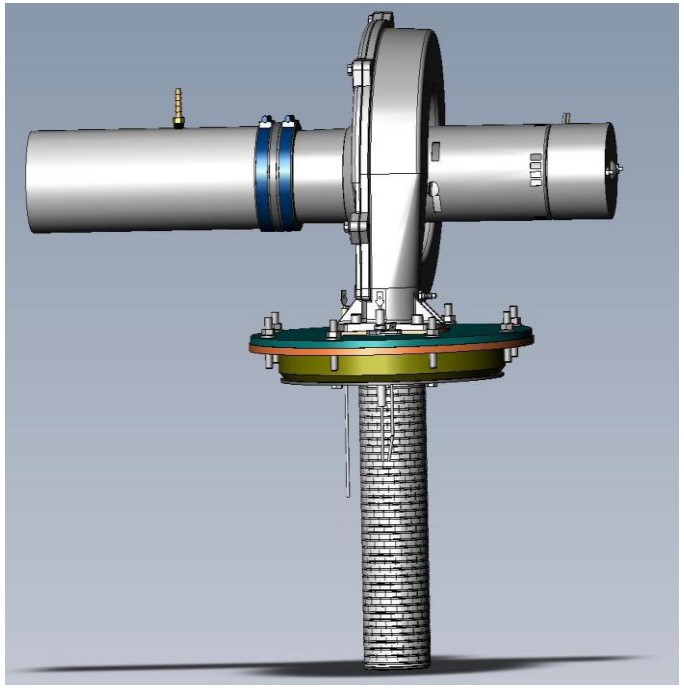
150 – 250 Models Combustion System

- Enhanced Blower
- Natural Gas Valve/Venturi Assy with 052 Venturi
- LP Gas Valve/Venturi Assy with 052 Venturi
- Burner
- Spark Electrode
  - .125” Spark Gap (between spark rod and ground rod)
  - ¼” – 5/16” away from burner surface
- Flame Rod
  - ½” away from burner surface
- Aluminum Burner/Blower Adaptor
- Burner Plate 6-Bolt Hole Pattern
- 409 SS Heat Shield



300 – 500 Models Combustion System

- Blower w/Hall Effect Sensor (RPM feed back). Smaller blower foot
- Gas Valve
- New Venturi Insert (Grey)
- 70mm Burner
- 409 SS Heat Shield
- 1” Pyrolite Insulation Block
- Heat Shield and Insulation Block (bolted to the Burner Plate w/SS bolts and spacers)
- Burner Plate 8-Bolt Hole Pattern
- Spark Electrode (different bend then 120-250)
  - .125” Spark Gap (between spark rod and ground rod)
  - ¼” – 5/16” away from burner surface
- Flame Rod (Longer Ceramic) and Bent away from Burner
  - ¾” away from burner surface



Key Marketing Features

- Modulation benefits
  - Increased efficiency at lower firing rates
  - Fewer cycles result in longer service life
  - Quieter operation at lower fire rates
- Modulation details
  - Modulates when within 30 degrees of set point
  - Input lowers closer to set point
  - Up to 3:1 modulation from largest model in family (120, 250, 500)

Modulation Details Continued…

- Utilizes **PID** algorithm
- Proportional
  - 30°F proportional band
    - Full fire if temperature is >30°F below setpoint
    - Proportional to difference
      - Full fire at 30°F
      - Minimum rate fire at set point
- Integral
  - Adds more speed the longer below set point
  - Subtracts speed the longer above set point
- Differential
  - Looks ahead with rapid changes to adjust output

Modulation Details Continued…

- After 8 min of continuous operation unit accelerates to full fire/RPM for 45 seconds
- All blowers have RPM feedback back to controller
  - 3 model families (120, 150-250,300-500) all have same pre-purge, ignition and post ignition RPM's
- Thermostat differential remains factory set at 8 degrees
- Tank temp remains 12:1 upper probe to lower probe

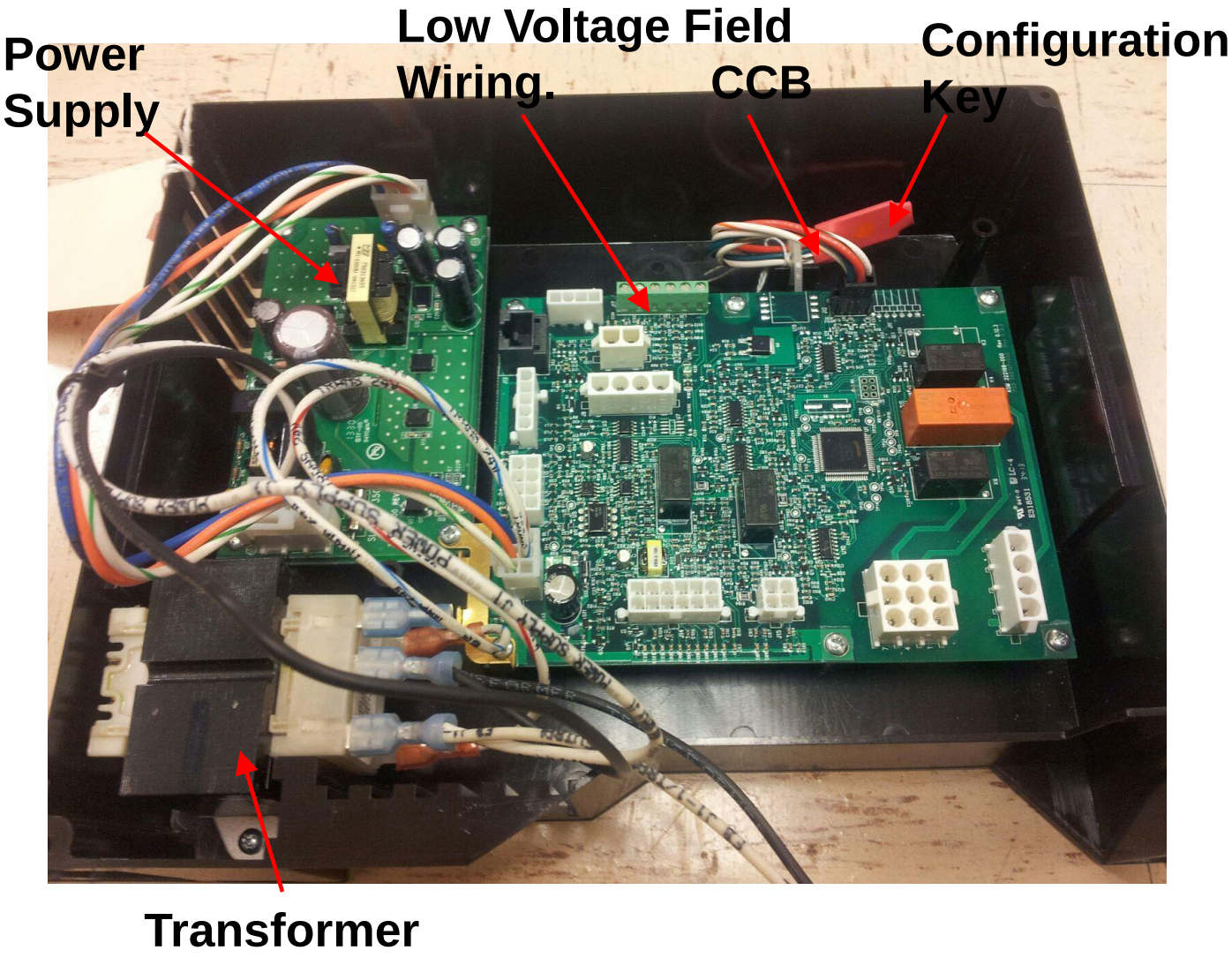
Venting

- **3” & 4” vent size for 120 – 250 (Same as current models)**
- **4” & 6” vent size for 300 – 500 (Same as current models)**
- **Same max. equivalent vent length as current production**
- **PVC, CPVC, PP, AL29-4C Vent Materials**
  - **ULC S636 Approved**
  - **Approved Polypropylene- M&G Duravent and Centrotherm InnoFlue**
  - **Approved AL29-4C are HeatFab Saf-T and Duravent FasNSeal**

Venting

- **Vents lengths unchanged**
- **Vent terminations**
  - **Standard termination (45 degree intake and 45 degree exhaust)**
  - **Concentric venting termination (Optional)**
    - **120 to 250 use 3” concentric**
    - **300 to 500 use 6” concentric**
  - **Low profile venting termination (Optional)**
    - **3 & 4” options (120 to 250)**
    - **4 & 6” options (300 to 500)**

New Control Box



New Control Sequence of Operation

- Simplified Sequence
  - Call for heat
    - Pre-purge
    - Slow down blower and start spark
    - Wait for blower to stabilize
    - Turn on gas valve
    - Wait for flame signal
    - Ramp up to post ignition speed and wait
    - Ramp down to heating speed (or modulation)
  - End Call for heat
    - Post-purge speed
    - Standby

Powered Anode

- Algorithm to adapt setpoint to low conductivity
- Calibration checks of hardware and tank on power up and just under every two hours
- New probe improvements to eliminate shorting at spud
- Higher currents (up to 175mA)

Model Families

- 120 Model
  - Max modulation down to 78,000 Btu/h
  - Single anode
- 150 - 250 Models
  - Max modulation down to 78,000 Btu/h
  - Common parts on 150 – 250 models
- 300 – 500 Models
  - Max modulation down to 195,000 Btu/h
  - VFD (variable frequency drive)
  - Common parts on 300 – 500 models

Things to Know

- Replacements will require vent realignment
- Blower ramps up/down
- Blower sound at high RPM with no intake
- 300 – 500 models are all 119 gallon now
- 300 model requires larger 4” concentric now
- 300-500 models are ¼” taller
- High altitude up to 10,100 ft
- We will market modulation and its benefits but not publish 3:1 modulation rates

Rated Thermal Efficiencies

Model Size	Previous Series	New Series
120	94%	95%
150	95%	98%
199	95%	97%
250	95%	96%
300	96%	96%
400	95%	95%
500	95%	95%

Reliability Improvements

- Change to spark ignition
- Modulation (fewer cycles and less thermal stress)
- New vertically mounted pressure switches
- Larger diameter fire tube (150 – 500 models)
- Fire tube cone transition
- Improved condensate drain
- Powered anode enhancements
- Improved low gas operation
- Smoother light off

New/Enhanced Features

- Modulation
- Increased efficiency
- Easy access exhaust and condensate
- New vent material options
- New low profile vent termination kits
- Addition of recirculation loop return connection
- Common parts

Summary

- The best just got better, the bar has been raised again
- New Series
- No price increase related to these improvements
- All model sizes released and ready for order

New Series Condensing Htrs Summary

- Combination of feature and reliability improvements
- No price increase related to these improvements

Installations

- Tim Hortons
- Hotels – Holiday Inn, Country Inn Suites, Canad Inns, Victoria Inn
- Apartments – Sussex Properties, Globe Agencies, Rancho Properties, ASH Mgmt.
- Sports and Rec – Canlan, Civic Center, PanAm Pool(pending)
- Food Processing – Maple Leaf Foods, Dunn Rite

Installations (con’t)

- Schools – Strathmillan School, Sansome School
- Hospitals – None yet
- Car Wash – Portage la Prairie (replaced HW’s)
- Restaurants – Olive Garden, Red Lobster

Targets

- PPMA
- Restaurant Association
- Hotel Association
- City of Winnipeg
- School Boards
- Hospitals

MB Hydro Incentive

http://www.hydro.mb.ca/your_business/hvac/ng_water_heating_systems.shtml

Design Issues

- Flexible gas pipe cannot be used, when more than one heater is installed an individual gas regulator is highly recommended, vent pipe is now in the front of the unit for easy access and gas pressure drops greater than 1” w.c. is not permitted as per code

Due to the turbulence caused by the inside corrugation, It causes the radial fired burner to pulsate and possible delayed ignition issues.

Mechanical Room Designs

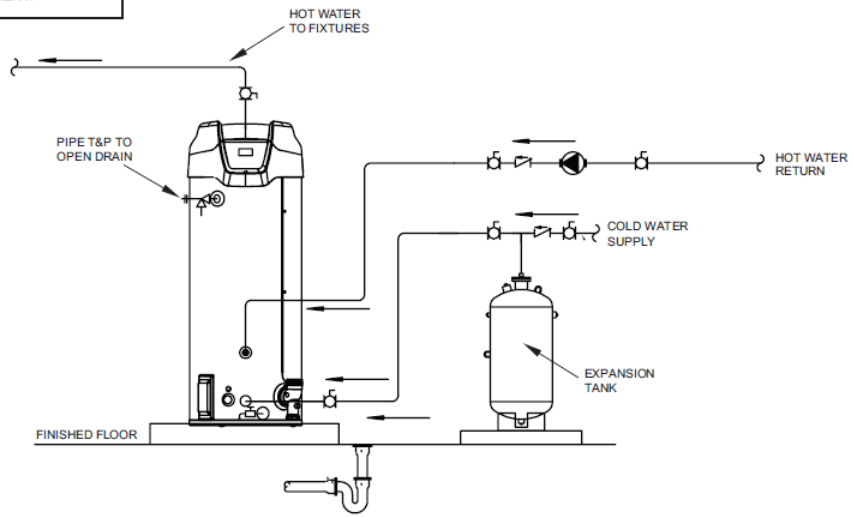
CYCLONE MXi BTH - ONE WATER HEATER WITH BUILDING RECIRCULATION (ONE TEMPERATURE)

WARNING: THIS DRAWING SHOWS SUGGESTED PIPING CONFIGURATION AND OTHER DEVICES; CHECK WITH LOCAL CODES AND ORDINANCES FOR ADDITIONAL REQUIREMENTS.

ANY MATERIAL, COMPONENT OR VENDOR CHANGE MUST HAVE PRIOR APPROVAL BY THE APPLICABLE PRODUCT ENGINEERING DEPARTMENT.

LEGEND

- TEMPERATURE & PRESSURE RELIEF VALVE
- TEMPERATURE CONTROL PROBE
- CHECK VALVE
- PRESSURE RELIEF VALVE
- DRAIN
- TEMPERATURE GAGE
- CIRCULATING PUMP
- FULL PORT BALL VALVE
- WATER FLOW SWITCH



NOTES:

1. Preferred piping method.
2. The temperature and pressure relief valve setting shall not exceed pressure rating of any component in the system.
3. Service valves are shown for servicing unit. However, local codes shall govern their usage.

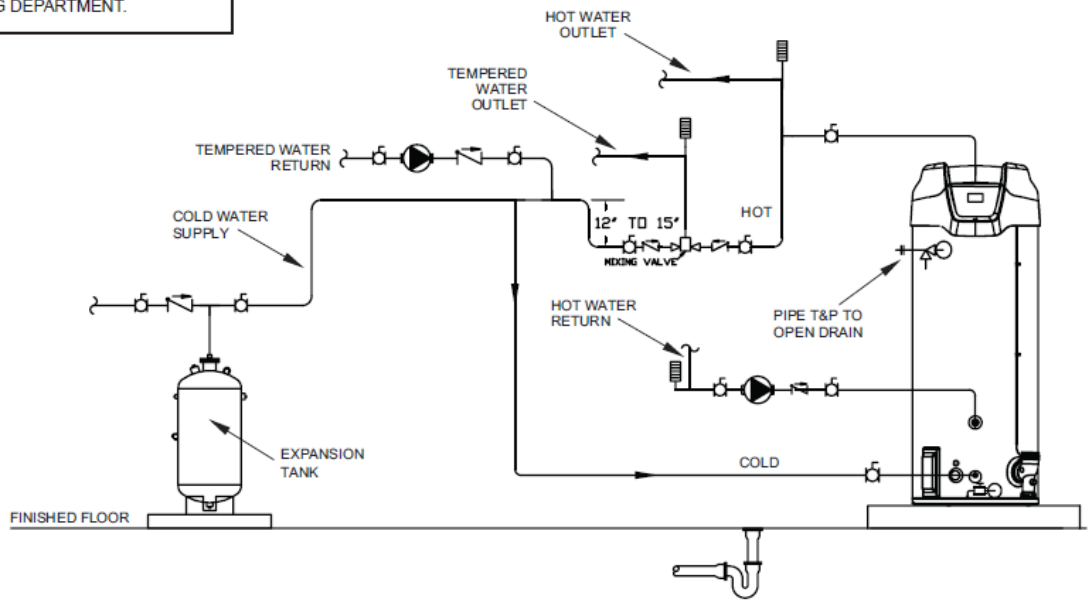
CYCLONE MXi BTH - ONE WATER HEATER WITH HIGH TEMPERATURE RECIRCULATION LOOP AND BUILDING RECIRCULATION (TWO TEMPERATURE)

WARNING: THIS DRAWING SHOWS SUGGESTED PIPING CONFIGURATION AND OTHER DEVICES; CHECK WITH LOCAL CODES AND ORDINANCES FOR ADDITIONAL REQUIREMENTS.

ANY MATERIAL, COMPONENT OR VENDOR CHANGE MUST HAVE PRIOR APPROVAL BY THE APPLICABLE PRODUCT ENGINEERING DEPARTMENT.

LEGEND

- TEMPERATURE & PRESSURE RELIEF VALVE
- PRESSURE RELIEF VALVE
- CIRCULATING PUMP
- TEMPERATURE CONTROL PROBE
- DRAIN
- FULL PORT BALL VALVE
- MIXING VALVE
- CHECK VALVE
- TEMPERATURE GAGE
- WATER FLOW SWITCH



NOTES:

1. Preferred piping method.
2. The temperature and pressure relief valve setting shall not exceed pressure rating of any component in the system.
3. Service valves are shown for servicing unit. However, local codes shall govern their usage.

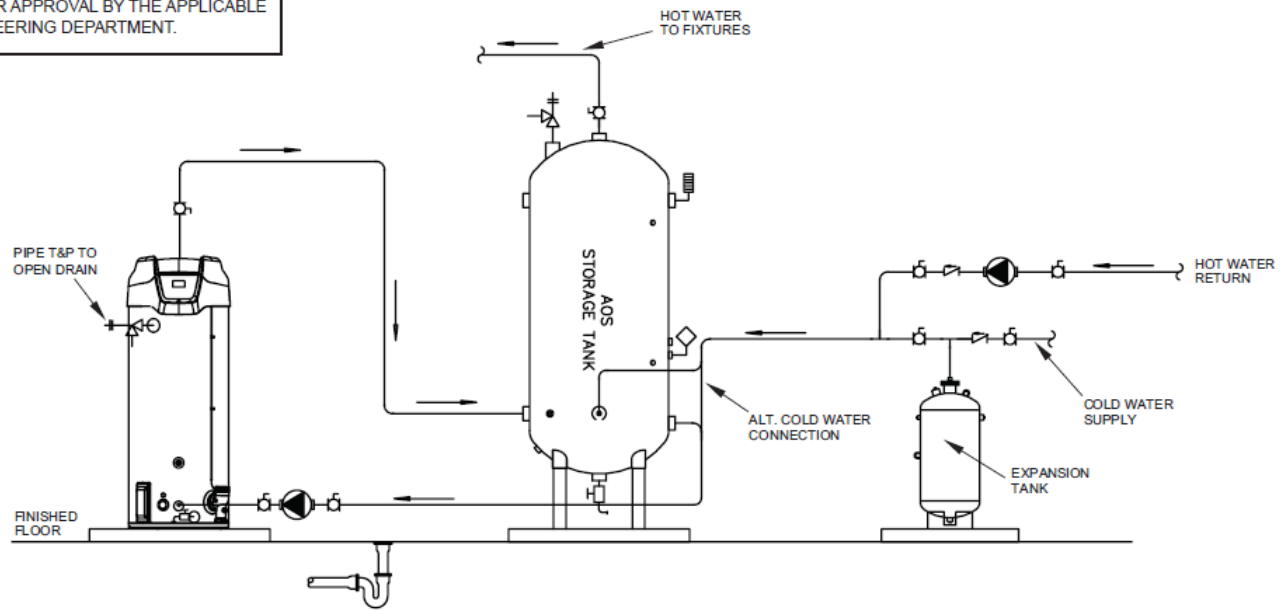
CYCLONE MXi BTH - ONE WATER HEATER WITH VERTICAL STORAGE TANK, FORCED RECIRCULATION AND BUILDING RECIRCULATION (ONE TEMPERATURE)

WARNING: THIS DRAWING SHOWS SUGGESTED PIPING CONFIGURATION AND OTHER DEVICES; CHECK WITH LOCAL CODES AND ORDINANCES FOR ADDITIONAL REQUIREMENTS.

ANY MATERIAL, COMPONENT OR VENDOR CHANGE MUST HAVE PRIOR APPROVAL BY THE APPLICABLE PRODUCT ENGINEERING DEPARTMENT.

LEGEND

- TEMPERATURE & PRESSURE RELIEF VALVE
- TEMPERATURE CONTROL PROBE
- CHECK VALVE
- PRESSURE RELIEF VALVE
- DRAIN
- TEMPERATURE GAGE
- CIRCULATING PUMP
- FULL PORT BALL VALVE
- WATER FLOW SWITCH



NOTES:

1. Preferred piping method.
2. The temperature and pressure relief valve setting shall not exceed pressure rating of any component in the system.
3. Service valves are shown for servicing unit. However, local codes shall govern their usage.
4. The tank temperature control should be wired to and control the pump between the water heater(s) and the storage tank(s).
5. The water heater's operating thermostat should be set 5 degrees F higher than the tank temperature control.

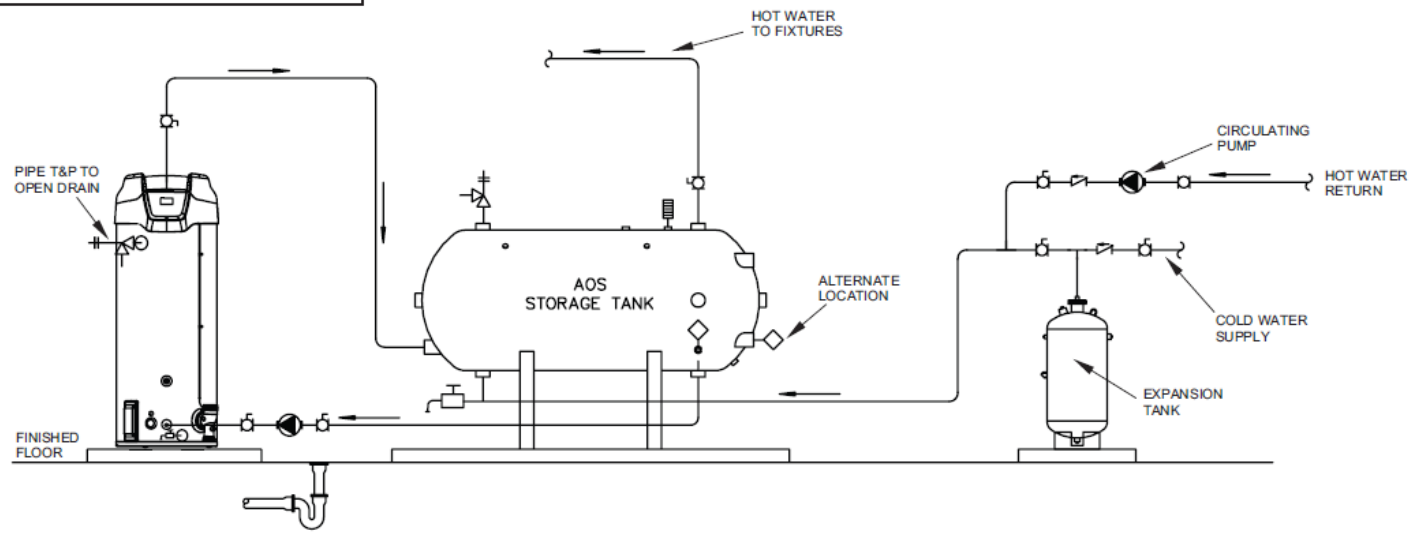
CYCLONE MXi BTH - ONE WATER HEATER WITH HORIZONTAL STORAGE TANK, FORCED RECIRCULATION AND BUILDING RECIRCULATION (ONE TEMPERATURE)

WARNING: THIS DRAWING SHOWS SUGGESTED PIPING CONFIGURATION AND OTHER DEVICES; CHECK WITH LOCAL CODES AND ORDINANCES FOR ADDITIONAL REQUIREMENTS.

ANY MATERIAL, COMPONENT OR VENDOR CHANGE MUST HAVE PRIOR APPROVAL BY THE APPLICABLE PRODUCT ENGINEERING DEPARTMENT.

LEGEND

- TEMPERATURE & PRESSURE RELIEF VALVE
- TEMPERATURE CONTROL PROBE
- CHECK VALVE
- PRESSURE RELIEF VALVE
- DRAIN
- TEMPERATURE GAGE
- CIRCULATING PUMP
- FULL PORT BALL VALVE
- WATER FLOW SWITCH



NOTES:

1. Preferred piping method.
2. The temperature and pressure relief valve setting shall not exceed pressure rating of any component in the system.
3. Service valves are shown for servicing unit. However, local codes shall govern their usage.
4. The tank temperature control should be wired to and control the pump between the water heater(s) and the storage tank(s).
5. The water heater's operating thermostat should be set 5 degrees F higher than the tank temperature control.

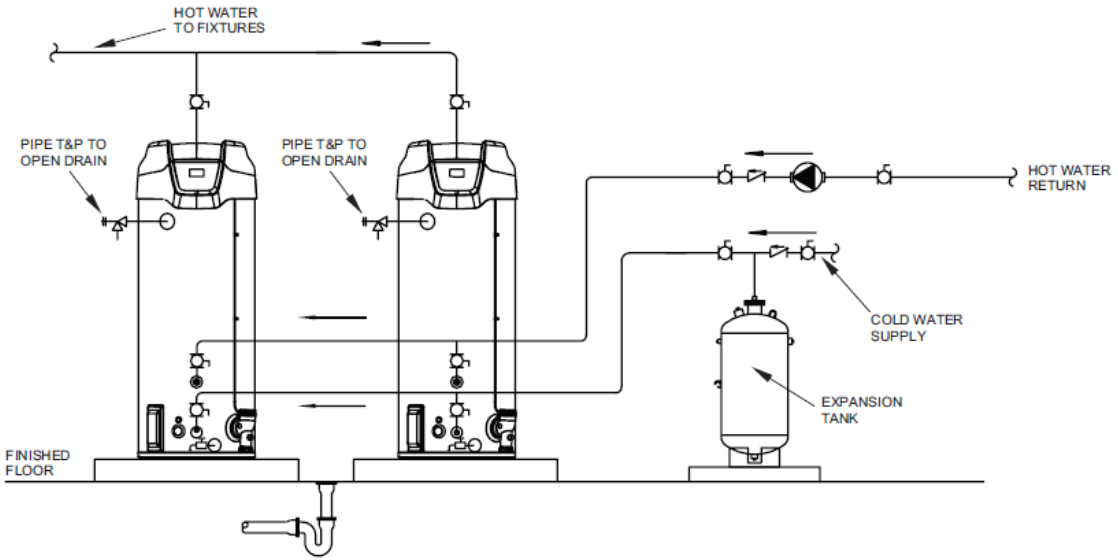
CYCLONE MXi BTH - TWO WATER HEATERS WITH BUILDING RECIRCULATION (ONE TEMPERATURE)

WARNING: THIS DRAWING SHOWS SUGGESTED PIPING CONFIGURATION AND OTHER DEVICES; CHECK WITH LOCAL CODES AND ORDINANCES FOR ADDITIONAL REQUIREMENTS.

ANY MATERIAL, COMPONENT OR VENDOR CHANGE MUST HAVE PRIOR APPROVAL BY THE APPLICABLE PRODUCT ENGINEERING DEPARTMENT.

LEGEND

- TEMPERATURE & PRESSURE RELIEF VALVE
- TEMPERATURE CONTROL PROBE
- CHECK VALVE
- PRESSURE RELIEF VALVE
- DRAIN
- TEMPERATURE GAGE
- CIRCULATING PUMP
- FULL PORT BALL VALVE
- WATER FLOW SWITCH



NOTES:

1. Preferred piping method.
2. The temperature and pressure relief valve setting shall not exceed pressure rating of any component in the system.
3. Service valves are shown for servicing unit. However, local codes shall govern their usage.

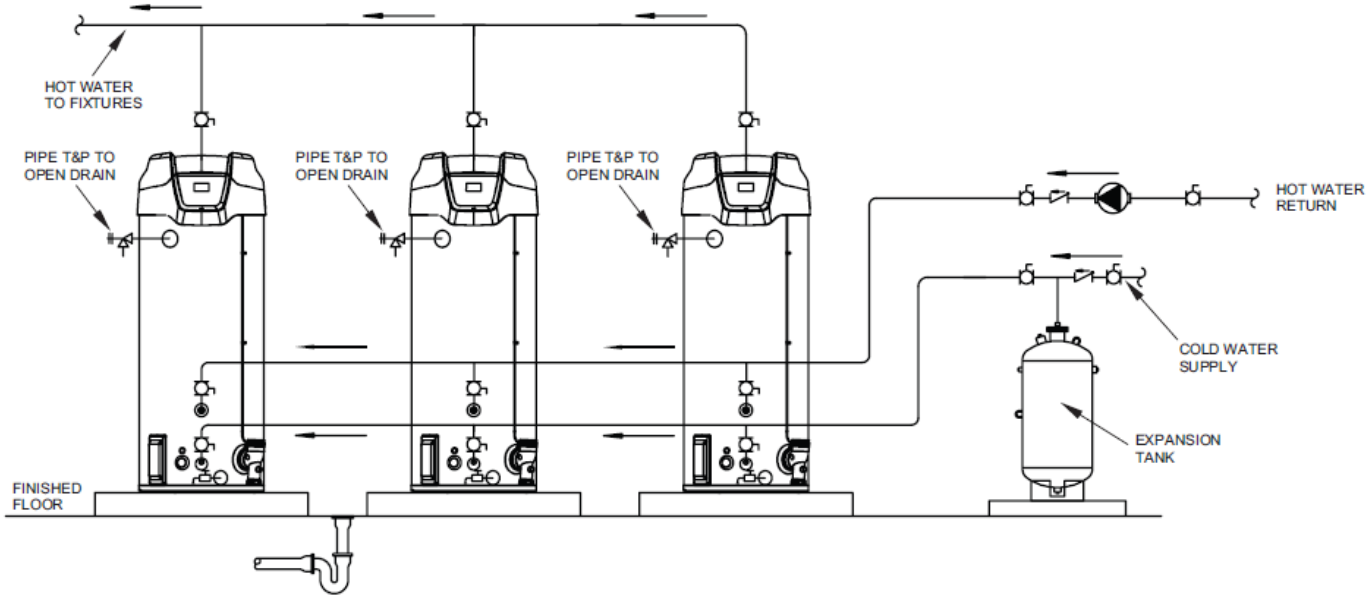
CYCLONE MXi BTH - THREE WATER HEATERS WITH BUILDING RECIRCULATION (ONE TEMPERATURE)

WARNING: THIS DRAWING SHOWS SUGGESTED PIPING CONFIGURATION AND OTHER DEVICES; CHECK WITH LOCAL CODES AND ORDINANCES FOR ADDITIONAL REQUIREMENTS.

ANY MATERIAL, COMPONENT OR VENDOR CHANGE MUST HAVE PRIOR APPROVAL BY THE APPLICABLE PRODUCT ENGINEERING DEPARTMENT.

LEGEND

- TEMPERATURE & PRESSURE RELIEF VALVE
- TEMPERATURE CONTROL PROBE
- CHECK VALVE
- PRESSURE RELIEF VALVE
- DRAIN
- TEMPERATURE GAGE
- CIRCULATING PUMP
- FULL PORT BALL VALVE
- WATER FLOW SWITCH



NOTES:

1. Preferred piping method.
2. The temperature and pressure relief valve setting shall not exceed pressure rating of any component in the system.
3. Service valves are shown for servicing unit. However, local codes shall govern their usage.

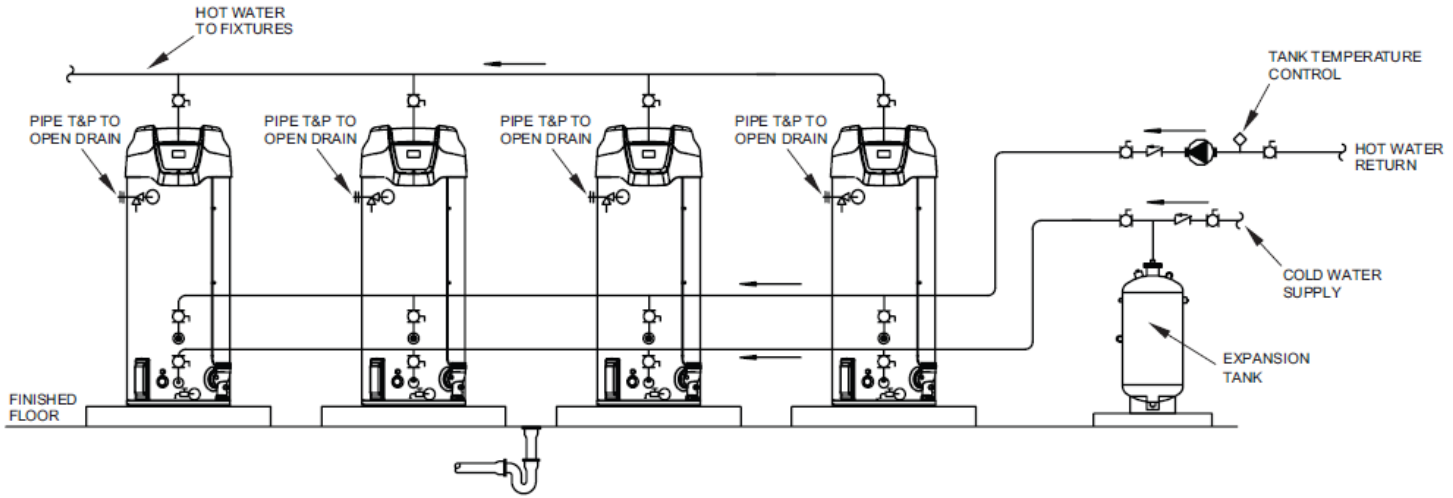
CYCLONE MXi BTH - FOUR WATER HEATERS WITH BUILDING RECIRCULATION
(ONE TEMPERATURE)

WARNING: THIS DRAWING SHOWS SUGGESTED PIPING CONFIGURATION AND OTHER DEVICES; CHECK WITH LOCAL CODES AND ORDINANCES FOR ADDITIONAL REQUIREMENTS.

ANY MATERIAL, COMPONENT OR VENDOR CHANGE MUST HAVE PRIOR APPROVAL BY THE APPLICABLE PRODUCT ENGINEERING DEPARTMENT.

LEGEND

- TEMPERATURE & PRESSURE RELIEF VALVE
- TEMPERATURE CONTROL PROBE
- CHECK VALVE
- PRESSURE RELIEF VALVE
- DRAIN
- TEMPERATURE GAGE
- CIRCULATING PUMP
- FULL PORT BALL VALVE
- WATER FLOW SWITCH



NOTES:
1. Preferred piping method.
2. The temperature and pressure relief valve setting shall not exceed pressure rating of any component in the system.
3. Service valves are shown for servicing unit. However, local codes shall govern their usage.

Venting

- Flexible
- Conventional power vented
- Vented directly vertical or horizontal
- Vent connections are located in the front
- Requires ULC, S636 PVC, CPVC, Polypropylene or AL29-4C stainless steel

Concentric Vent

INSTALLATION INSTRUCTIONS

Concentric Vent Termination Kit 9004580

INTRODUCTION

This instruction covers installation of the concentric vent termination kit, Part No. 194451 on BTH 120, 150, 199, 250 and 300 Cyclone XHE water heaters.

KIT COMPONENTS

Each kit is comprised of the following:

Item	Description	Qty.
Rain Cap	3 in.	1
SDR-26 pipe	4 in. dia.	1
SDR-26 Pipe	2-1/2 in. dia.	1
Y Concentric Fitting	3 in.	1
Installation Instructions	194504-000	1

Note: Read the entire instruction manual before starting the installation.

Field supplied pipe and fittings are required to complete the installation.

This concentric vent termination kit may be used with 3 or 4 in. diameter pipe systems. When connecting to a 4 in. diameter pipe system a 3 x 4 in. field supplied reducer is to be installed at the intake and exhaust connection of the concentric vent termination kit.

See water heater installation and operation manual for venting specification.

SAFETY CONSIDERATIONS

Installing and servicing water heating equipment can be hazardous due to gas and electrical components. Only trained personnel should install or service this equipment. All precautions in the literature, on tags, and labels attached to the unit must be observed.

Follow all safety codes. Wear safety glasses and work gloves. Have a fire extinguisher available.

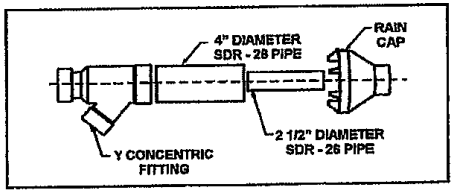


Figure 1.

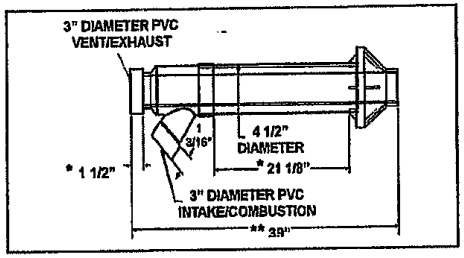


Figure 2.

* **Dimension 21-1/8 in. may be lengthened to 60 in. maximum. Dimension 21-1/8 in. may also be shortened by cutting the pipes, provided in the kit, to 12 in. minimum.**

** **Dimension 39 in. will change accordingly as dimension 21-1/8 in. is lengthened or shortened.**

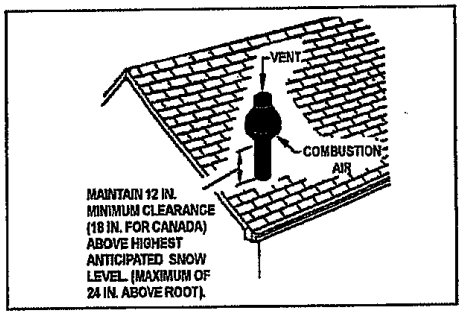


Figure 3.

INSTALLATION PROCEDURE 1 - ROOF TERMINATION See Figure 3.

1. Determine best location for termination kit

NOTE: Roof termination is preferred since it is less susceptible to damage, has reduced chances to intake contaminants, and less visible vent vapors.

2. Cut one hole (5 in. diameter)

3. Partially assemble concentric vent termination kit.
   a) Cement Y concentric fitting to larger diameter kit pipe. See Figure 1.
   b) Cement rain cap to smaller diameter kit pipe. See Figure 1.

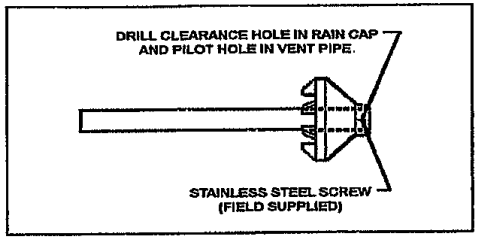


Figure 4.

NOTE: Instead of cementing the smaller pipe to the rain cap, a field-supplied stainless steel screw may be used to secure the two components together when field disassembly is desired for cleaning. See Figure 4.

⚠ WARNING

When using alternate screw method, drill clearance hole in rain cap and pilot hole in vent pipe for screw size being used. Failure to drill adequate holes may cause cracking of PVC components, allowing combustion products to be recirculated. Failure to follow this warning could result in personal injury or death.

⚠ WARNING

Do not operate the heater with rain cap removed or recirculation of combustion products may occur. Water may also collect inside larger combustion-air pipe and flow to the burner enclosure. Failure to follow this warning could result in product damage or improper operation, personal injury or death.

4. Install Y concentric fitting and pipe assembly through structure's hole and field supplied roof boot/flashing.

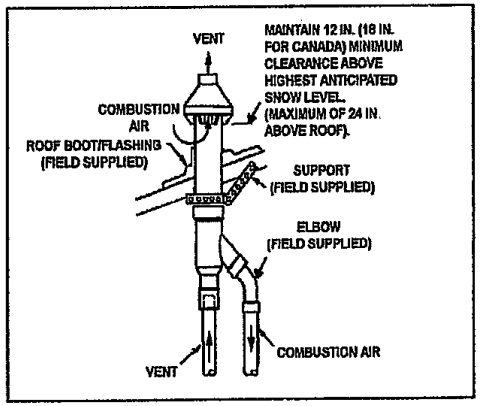


Figure 5.

NOTE: Do not allow insulation or other materials to accumulate inside pipe assembly when installing through hole.

5. Secure assembly to roof structure as shown in Figure 5 using field supplied metal strapping or equivalent support material.

NOTE: Ensure termination height is above the roof surface or anticipated snow level (1 ft. in U.S.A. or 45.72 cm in Canada). See Figure 3.

6 Install rain cap and small diameter pipe assembly in roof penetration assembly, Ensure small diameter pipe is cemented and bottomed in Y concentric fitting

7. Cement heater combustion-air and vent pipes to concentric vent termination assembly. See Figure 5 for proper pipe attachment.

8. Operate heater through one heat cycle to ensure combustion-air and vent pipes are properly connected to concentric vent termination connections.

NOTE: All vent terminations must be the same height when installing multiple unit venting. If assembly is too short to meet height requirement, the two pipes supplied in the kit may be replaced by using same diameter, field supplied SDR-26 PVC (D2241) pipe. Do not extend the 21-1/8" dimension to be more than 60 inches. See Figure 2.

⚠ CAUTION

Do not use field-supplied couplings to extend pipes. Airflow restriction will occur and the heater pressure switch may cause intermittent operation.

PROCEDURE 2 – SIDE WALL TERMINATION See Figure 6.

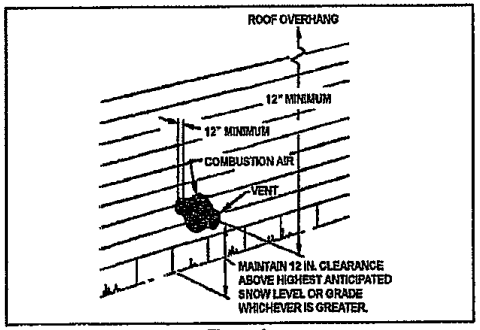


Figure 6.

1. Determine best location for termination kit.

NOTE: Consideration for the following should be used when determining an appropriate location for the termination kit:

- Termination kit positioned where the vent vapors will not damage plants/shrubs or air conditioning equipment

Market Trends

- Times are changing
- EFFICIENCY is money
- Money is good
- We all want it

Condensing HWT History

- 1990 – What was it
- 1995 – We will listen
- 2000 – Not enough history
- 2005 – You try it
- 2010 – Maybe I should/will
- 2015 – Let’s do it

Market Share

	Atmospheric Tank Type	Condensing
Pre 2000	95%	5%
2000-2010	80%	20%
2013	60%	40%
2015	40%	60%

Why the change?

- Not price
- Reliability
- Education
- Foot print
- Payback / Energy Savings
- Design
- Security
- Makes sense

Payback Calculator

http://www.hotwatersizing.com/PaybackCalculator.aspx

Thank you