Technical Application Guide

AM Series Piping Application Guide

Natural Gas & Propane Modulating Condensing Boilers and Hot Water Heaters

Applies to the following AM Series models:

**AM Boilers**
- AM 399B
- AM 500B
- AM 750B
- AM 1000B

**AM Water Heaters**

**Standard Models:**
- AM 399W
- AM 500W
- AM 750W
- AM 1000W

**Rapid Recovery:**
- AM 199R
- AM 250R
- AM 399R
- AM 500R
- AM 750R
- AM 1000R

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SEC 1: MANDATORY REQUIREMENTS

The following are mandatory actions required to ensure proper piping and drainage of the AM Series system.

CAUTION!

Local codes and authorities should be consulted prior to installation.

- AERCO requires that the boiler loop to be de-coupled from the system loop. This can be achieved by one of the following:
  - Employing primary-secondary piping.
  - Installation of a hydraulic separator between the boiler and the system loop.
  - Installation of a heat exchanger (for example, plate heat exchanger) between the boiler and the system loop.
- For water heating installations, a storage tank provides the required de-coupling.
- AERCO requires cleaning of the whole system and to fit a mandatory Y-strainer on the return pipe to the boiler, equipped with isolation valves (See Figures 11 to 18 at the end of this document).
- For boiler replacement installations, cleaning of the whole system is required before connecting the boiler (See Section 2.3 for Flushing, Treatment, and Cleansing tips and guidelines). Failure to clean a system will limit it from the full benefits offered by the high efficiency AM Series.
- Boiler drain valve and condensate neutralizer drain should be arranged to permit the fluids to drain freely, by gravity, to a convenient floor drain.
- For units installed in environments likely to experience freezing temperatures, it is necessary to ensure that the condensate line and exhaust manifold are equipped with suitable freeze protection, such as a heat trace line or insulation.
- All piping and electrical connections (i.e. service switches, conduit boxes, etc.) should be located at a minimum of 6 inches from the boiler panels and covers.
- See Table 1 (Section 2) for sizing guidelines for the mandatory primary pump and boiler strainer.
- A discharge pipe must be used and must not have an internal cross-sectional area less than the outlet of the relief valve.
- The discharge pipe must be installed so that there will be no danger of scalding to the boiler attendants. See Figure 1 for a discharge pipe example of an AM Series unit.
- The relief valve point of discharge piping must have provisions for proper drainage.
- When connecting the hot water outlet and cold water inlet to building piping, first make sure the threads are thoroughly clean. AERCO recommends using Loctite ® 7649 to prime the threads and then Loctite 567 as pipe dope. **Do NOT use Teflon tape.**
CAUTION!
Each relief valve must have its own discharge piping all the way to the point of discharge, and must never be manifolded, attached to, or combined with any other piping.

Figure 1: AM 399/500 Relief Valve Point of Discharge Example
SEC 2: BOILER QUALITY AND MAINTENANCE

2.1. BOILER WATER CHEMISTRY

2.1.1. Scale and Corrosion
Free oxygen can cause the formation of rust (iron oxides), which degrade metallic materials. Magnetite is formed in uninhibited water if there is electrolytic action in the presence of oxygen. Sludge is formed when calcium compounds, primarily CaCO3, are heated. Rust and magnetite, when combined with sludge, can form a very hard scale, which significantly reduces system efficiency and life expectancy of the heating system. Scale reduces heat exchange due to its low heat conductivity and so may cause very dangerous localized overheating. Waterside corrosion of all heating circuit surfaces is also a major concern.

2.1.2. Make-up or Feed Water Quality
Make-up or feed water is water added to a closed hydronic system to replenish water lost through evaporation, maintenance, or leakage. The quality of make-up or feed water, which may contain dissolved oxygen, minerals and other dissolved contaminants, is extremely important. Such introduced water must be chemically treated or strictly limited when ensuring neutral chemical conditions in boiler system water. Generally, any closed hydronic heating system should be restricted from receiving untreated makeup water of no more than 5% of the total volume of system water per year.

2.1.3. Treating Water to Prevent Freezing
When using anti-freeze solutions, their compatibility with the AM Series 316 (Ti) heat exchanger and other components of the heating system must be determined prior to use. If a glycol solution is used as anti-freeze protection, a backflow preventer must be installed upstream of the fill/makeup valve.

Only virgin glycol should be used for systems requiring freeze protection, and it must be treated with an inhibitor compatible with the particular chemical treatment being used in the system. Note that glycol must be changed from time to time due to its limited useful life.

Use only inhibited propylene glycol solutions, formulated for hydronic systems. Ethylene glycol is toxic and can attack gaskets and seals used in hydronic systems.

2.1.4. Water Treatment Certification
When using chemical treatments in hydronic systems, it is necessary to ensure that the chosen treatment is appropriate and certified by the manufacturer for such environments. The manufacturer should also guarantee that the treatment, when applied according to the manufacturer’s recommendations, will not cause harm to the boiler, pumps, piping, and other components of the hydronic boiler system.
2.2. TESTING AND MAINTENANCE OF WATER QUALITY

Water in the installation should be checked, monitored, and treated for the following conditions and characteristics:

- **Hardness** – High hardness of the available water is measured in grains of hardness and indicates the quantity of minerals (mostly calcium and magnesium) which are dissolved in the water. Hardness substantially contributes to the formation of scaling, which is highly undesirable. The total water hardness must be less than 200 ppm total dissolved solids (TDS) and 310 ppm TDS in open loop water heating applications.

- **Artificial Softness** – Do **NOT** use artificially softened water. Artificial softening agents generally use salt, which creates a chloride water chemistry, a major contributor to the corrosion of the types of metals used in hydronic systems. Elevated salt levels also contribute to higher conductivity levels, another undesirable characteristic in hydronic systems.

- **Chloride** – Chlorides are salts resulting from the combination of the gas chlorine with a metal and are instrumental in accelerating corrosion in the types of metals used in hydronic systems. Chlorides may be introduced into the water naturally. Concentrations of chlorides in system water should be less than 150 ppm.

- **Conductivity** – Dissolved metals and minerals increase the conductivity of water and indicate not only the presence of undesired corrosive agents, but also contribute to the transfer and migration of ions and charged particles in the water that contribute to fouling of sensors, valves, and other devices used in the system. Additionally, high conductivity contributes to galvanic corrosion, in which one metal will preferentially corrode when in contact with another type of metal, when both are in contact with an electrolyte. Conductivity should be less than 3000 μS.

- **pH** – The pH, a measure of the acidic, neutrality, and alkalinity of the water, must always be between 7.5 and 9.5 pH.

- **Oxygen** – All precautions should be taken to avoid the formation and localization of oxygen in the water of a heating system. Water that is low in minerals (soft water) absorbs oxygen much more readily than mineralized (hard) water. For this reason it is necessary that in heating systems using floor radiant heating, the plastic pipes used be impermeable to oxygen.

- **Scale and Corrosion** – The use of an inhibitor is advisable to treat feed and make-up water and to protect heating systems against scale, corrosion and microbiologic growth. To prevent freezing, the use of an anti-freezing agent together with the inhibitor is advisable. Qualified companies can also provide boiler de-scaling.

- Water treatment is also advisable in the following cases:
  - Very large heating systems
  - High quantities of replenished water due to leakages or maintenance work
2.3. SYSTEM FLUSHING, TREATMENT, AND CLEANSING

Note that prior to cleaning the heating system, **the boiler MUST be isolated from the piping to prevent infusion of containments, including sludge, into the boiler.** Section 2.3 provides recommendations for flushing, cleaning, and treating the water used in the AM Series system.

**IMPORTANT!**

Cleaning solution and inhibitors used must be compatible with heat exchanger material. Corrosion/scale inhibitor will be ineffective if added to a dirty system; therefore, it is very important to clean the system first.

AERCO recommends the following cleaning solution, inhibitor, and antifreeze products. Visit [www.aerco.com](http://www.aerco.com) for Product Fact sheet and Material Safety Data Sheets:

- **Water Quality Testing —** X100 Quick Test Kit
  Part number 99152-1
- **Corrosion/Scale Inhibitor —** Sentinel X100 Liquid Inhibitor
  4 x 1 gallon case – part number 99153-2
  5 gallon jug – part number 99153-1
- **Boiler Noise Reducer —** Sentinel X200 Liquid Noise Inhibitor
  4 x 1 gallon case – part number 99154-2
  5 gallon jug – part number 99154-1
- **System Cleaner —** Sentinel X300 Liquid System Cleaner
  4 x 1 gallon case – part number 99199-2
  5 gallon jug – part number 99199-1
- **Cleaning solution —** Sentinel X400 Liquid System Restorer
  4 x 1 gallon case – part number 99155-2
  5 gallon jug – part number 99155-1
- **Antifreeze —** Sentinel X500 Liquid Inhibited Antifreeze
  5 gallon jug – part number 99156-1
  55 gallon jug – part number 99156-2
  275 gallon tote – part number 99156-3

When cleaning, treating, and maintaining, a heating system, consult a qualified professional. The following are AERCO’s tips/guidelines for cleaning a heating system – these do NOT take precedence over detailed instructions from qualified professionals.

### 2.3.1. System Flushing Recommendations

- Make sure to use an appropriate amount of cleaning solution, carefully following the manufacturer’s instructions. Follow the chemical manufacturer’s recommendations when introducing cleaning agents into the system.
- Ensure that the cleaning solution is circulated thoroughly in the system.
- Flush the system thoroughly to remove the maximum amount of contaminants. When emptying the system, make sure it is done as quickly as possible using all drain off points and ensuring all low lying pipework is fully drained. Opening all bleed valves ensures the system will be completely emptied.
• A reliable test to determine if a system is clean is if the Total Dissolved Solids (TDS) of the water being drained is within 10% of the make-up water TDS. This indicates that sufficient contamination has been flushed from the system. If the difference in TDS is more than 10%, it is recommended to repeat the cleaning process until that is achieved. A turbidity test can be used as an alternate way to determine if a system is clean.

• For boiler retrofit/replacement installation, it will be necessary to repeat the cleaning process until the draining water appears to be clear. Once clear, the above TDS comparison (or a turbidity test) should be performed.

• If a flushing machine is used in the cleaning process, carefully follow the manufacturer’s instructions. If the flushing machine is designed to flush individual zones, the TDS comparison must be made between each zone and the make-up water, or the turbidity test performed for each zone.

• Add corrosion and scale inhibitor after the system has been declared clean, using the appropriate amount recommended by the manufacturer. Introduce the protector/scale inhibitor to the system following the chemical treatment manufacturer’s instructions. Adding inhibitor to a dirty system reduces its effectiveness.

When refilling the system, ensure the boiler is not air-bound by opening the pressure-relief valve located at the rear of the boiler. Leave the relief valve open until a steady flow of water is observed. Close the valve and finish filling the system.

2.3.2. Water Quality Maintenance and Boiler Warranty

Heat exchanger failures due to improperly cleaned/treated and poorly maintained water are not covered under warranty. Scheduled system/boiler water maintenance is required to maintain the heat exchanger warranty. AERCO shall reserve the right to require maintenance records when evaluating warranty claims.

2.3.3. Water Treatment Analysis and Scheduling

The proper mixture of water, chemical treatment, and glycol (if used) should be ascertained based on a sample of the system water and the make-up water. Your local water treatment company, or one of the manufacturers listed below, may analyze your sample. Adjust the chemical composition of your system water based on the analysis. After this initial analysis, the chemical composition of your system water should be tested at the beginning of each heating season. For boilers operating year round, this analysis should be made at least twice a year.

2.3.4. Boiler Loop Design Guidelines

For proper and safe operation of the water tube AM boiler, the primary (boiler) loop piping and the associated fittings and accessories must be designed/selected as discussed in the following sections. Table 2 shows the required minimum flow rates at various system designed temperature rises. Also shown are pressure drops through strainers typically needed in the boiler loop (see paragraph 2.5 for strainer requirement details).
The following primary/secondary piping design guidelines should be used for AERCO AM Series Boiler and Water Heater installations. The following data was calculated based upon systems with Return Water Temperatures above 80°F. A 20-mesh strainer (or finer) is required at each boiler inlet. Water flow rates and pressure drops shown below are for the primary loop. Flow rates vary with system design parameters. The boiler loop fittings and strainer pressure drops shown below are examples only – actual pressure drops will vary depending on actual piping layout and strainer size/type used. The pump kits listed are for boiler applications only and are not approved for potable water. See section 2.3.5 for potable water applications.

### TABLE 1: Minimum and Maximum Flow Rates

<table>
<thead>
<tr>
<th></th>
<th>AM 399</th>
<th>AM 500</th>
<th>AM 750</th>
<th>AM 1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Water Flow at Min. Fire (GPM)</td>
<td>11</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Minimum Water Flow at Full Fire (GPM)</td>
<td>22</td>
<td>24</td>
<td>36</td>
<td>48</td>
</tr>
<tr>
<td>Maximum Water Flow (GPM)</td>
<td>40</td>
<td>40</td>
<td>60</td>
<td>80</td>
</tr>
</tbody>
</table>

### TABLE 2: Flow Rate and Pressure Drop

<table>
<thead>
<tr>
<th></th>
<th>AM 500</th>
<th>AM 750</th>
<th>AM 1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>40°F ΔT Loop Conditions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Flow (GPM) @ 40°F ΔT</td>
<td>24</td>
<td>36</td>
<td>48</td>
</tr>
<tr>
<td>Water Pressure Drop (Ft. of Hd.) across the Boiler @ 40°F ΔT</td>
<td>14</td>
<td>14</td>
<td>16</td>
</tr>
<tr>
<td>Strainer ΔP (Ft. of Hd.) – (‘Y’ Strainer, 20 mesh)</td>
<td>0.85</td>
<td>0.56</td>
<td>1.00</td>
</tr>
<tr>
<td>ΔP (Ft. of Hd.) – (20’ SCH.40, 4 x 90°, 2 x reducing couplings, 2 x Ball Valve)</td>
<td>1.64</td>
<td>1.11</td>
<td>1.74</td>
</tr>
<tr>
<td>Total Primary Loop ΔP (Ft. of Hd.) @ ΔT of 40°F</td>
<td>16.48</td>
<td>16.67</td>
<td>18.73</td>
</tr>
</tbody>
</table>

**VARIABLE SPEED PUMP**

Recommended AERCO Pump Kit for piping configurations not exceeding the above example: 99251-1, 99251-2, 99251-2

Kit includes: Pump Flange Size: 1-1/2"

Recommended AERCO AM Boiler Installation Kit (Installation Kit already includes above Pump, plus Strainer, Isolation Valve, and pipe fittings): 58145-1, 58145-3, 58145-4

Installation Kit designed for supply/return piping diam: Strainer and isolation valves sizes (NPT): 1-1/2", 2", 2-1/2"

**CONSTANT SPEED PUMP**

Recommended AERCO Pump+Circuit Setter Kit for piping configurations not exceeding the above example: 99127-1, 99127-8, 99127-5

Kit includes: Pump Flange Size: 1-1/2"

Kit includes: Circuit Setter Size (NPT): 1-1/2", 2", 2-1/2"

Recommended AERCO AM Boiler Installation Kit (Installation Kit already includes above Pump/Circuit setter kit, plus Strainer, Isolation Valve, and pipe fittings): 58134-1, 58134-4, 58134-5

Installation Kit designed for supply/return piping diam: Strainer and isolation valves sizes (NPT): 1-1/2", 2", 2-1/2"
### 30°F ΔT Loop Conditions

<table>
<thead>
<tr>
<th></th>
<th>AM 399</th>
<th>AM 500</th>
<th>AM 750</th>
<th>AM 1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Flow (GPM) @ 30°F ΔT</td>
<td>24.5</td>
<td>30.7</td>
<td>46.0</td>
<td>61.3</td>
</tr>
<tr>
<td>Water Pressure Drop (Ft. of Hd.) across the Boiler @ 30°F ΔT Flow</td>
<td>13</td>
<td>25</td>
<td>23</td>
<td>27</td>
</tr>
<tr>
<td>Strainer ΔP (Ft. of Hd.) – (Y’ Strainer, 20 mesh)</td>
<td>0.96</td>
<td>0.44</td>
<td>1.00</td>
<td>1.77</td>
</tr>
<tr>
<td>ΔP (Ft. of Hd.) – (20’ SCH.40, 4 x 90°, 2 x reducing couplings, 2 x Ball Valve)</td>
<td>1.76</td>
<td>0.75</td>
<td>1.74</td>
<td>3.11</td>
</tr>
<tr>
<td>Total Primary Loop ΔP (Ft. of Hd.) @ ΔT of 30°F</td>
<td>15.72</td>
<td>26.19</td>
<td>25.73</td>
<td>31.88</td>
</tr>
</tbody>
</table>

#### VARIABLE SPEED PUMP

- Recommended AERCO Pump Kit for piping configurations not exceeding the above example
  - Kit includes: Pump Flange Size: 1-1/2", 1-1/2", 1-1/2", 2-1/2"  
  - Recommended AERCO AM Boiler Installation Kit (Installation Kit already includes above Pump, plus Strainer, Isolation Valve, and pipe fittings): 58145-1 58145-6 58145-4 58145-7  
  - Installation Kit designed for supply/return piping diam: Strainer and Isolation valves sizes (NPT): 1-1/2", 2", 2-1/2", 2-1/2"

#### CONSTANT SPEED PUMP

- Recommended AERCO Pump+Circuit Setter Kit for piping configurations not exceeding the above example
  - Kit includes: Pump Flange Size: 1-1/2", 1-1/2", 1-1/2", 1-1/2"  
  - Recommended AERCO AM Boiler Installation Kit (Installation Kit already includes above Pump/Circuit setter kit, plus Strainer, Isolation Valve, and pipe fittings): 58134-1 58134-6 58134-5 58134-5  
  - Installation Kit designed for supply/return piping diam: Strainer and Isolation valves sizes (NPT): 1-1/2", 2", 2-1/2", 2-1/2"

### 25°F ΔT Loop Conditions

<table>
<thead>
<tr>
<th></th>
<th>AM 399</th>
<th>AM 500</th>
<th>AM 750</th>
<th>AM 1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Flow (GPM) @ ΔT of 25°F</td>
<td>29.4</td>
<td>36.8</td>
<td>55.2</td>
<td>73.6</td>
</tr>
<tr>
<td>Water Pressure Drop (Ft. of Hd.) across the Boiler @ 25°F ΔT Flow</td>
<td>19</td>
<td>35</td>
<td>32</td>
<td>39</td>
</tr>
<tr>
<td>Strainer ΔP (Ft. of Hd.) – (Y’ Strainer, 20 mesh)</td>
<td>0.41</td>
<td>0.64</td>
<td>0.70</td>
<td>1.25</td>
</tr>
<tr>
<td>ΔP (Ft. of Hd.) – (20’ SCH.40, 4 x 90°, 2 x reducing couplings, 2 x Ball Valve)</td>
<td>0.71</td>
<td>1.21</td>
<td>0.92</td>
<td>1.76</td>
</tr>
<tr>
<td>Total Primary Loop ΔP (Ft. of Hd.) @ ΔT of 25°F</td>
<td>20.12</td>
<td>36.85</td>
<td>33.62</td>
<td>42.01</td>
</tr>
</tbody>
</table>

#### VARIABLE SPEED PUMP

- Recommended AERCO Pump+Circuit Setter Kit for piping configurations not exceeding the above example
  - Kit includes: Pump Flange Size: 1-1/2", 1 1/2", 2-1/2", 2-1/2"  
  - Recommended AERCO AM Boiler Installation Kit (Installation Kit already includes above Pump, plus Strainer, Isolation Valve, and pipe fittings): 58145-6 58145-6 58145-7 58145-7  
  - Installation Kit designed for supply/return piping diam: Strainer and Isolation valves sizes (NPT): 2", 2", 2-1/2", 2-1/2"
25°F ΔT Loop Conditions (Cont'd)

<table>
<thead>
<tr>
<th></th>
<th>AM 399</th>
<th>AM 500</th>
<th>AM 750</th>
<th>AM 1000</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CONSTANT SPEED PUMP</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recommended AERCO Pump+Circuit Setter Kit for piping configurations not exceeding the above example</td>
<td>99127-8</td>
<td>99127-8</td>
<td>99208-2</td>
<td>99208-2</td>
</tr>
<tr>
<td>Kit includes: Pump Flange Size:</td>
<td>1-1/2&quot;</td>
<td>1-1/2&quot;</td>
<td>2&quot;</td>
<td>2&quot;</td>
</tr>
<tr>
<td>Kit includes: Circuit Setter Size (NPT):</td>
<td>2&quot;</td>
<td>2&quot;</td>
<td>2-1/2&quot;</td>
<td>2-1/2&quot;</td>
</tr>
<tr>
<td>Recommended AERCO AM Boiler Installation Kit (Installation Kit already includes above Pump/Circuit setter kit, plus Strainer, Isolation Valve, and pipe fittings).</td>
<td>58134-6</td>
<td>58134-6</td>
<td>58134-7</td>
<td>58134-7</td>
</tr>
<tr>
<td>Installation Kit designed for supply/return piping diam: Strainer and Isolation valves sizes (NPT):</td>
<td>2&quot;</td>
<td>2&quot;</td>
<td>2-1/2&quot;</td>
<td>2-1/2&quot;</td>
</tr>
</tbody>
</table>

**NOTE:**
Units with outlet connections matching pipe size do not include reducer.

### 2.3.5. Potable Applications Primary Loop Design Guidelines

For proper and safe operation of the water tube AM water heater, the primary (heater) loop piping and the associated fittings and accessories must be designed/selected as discussed in the following sections. Table 3 shows the required minimum flow rates at various potable water hardness. Also shown are pressure drops through strainers typically needed in the boiler loop (see paragraph 2.5 for strainer requirement details).

#### TABLE 3: Minimum and Maximum Flow Rates

<table>
<thead>
<tr>
<th></th>
<th>AM 399</th>
<th>AM 500</th>
<th>AM 750</th>
<th>AM 1000</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Minimum Water Flow at Min. Fire (GPM)</strong></td>
<td>11</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td><strong>Minimum Water Flow at Full Fire (GPM)</strong></td>
<td>22</td>
<td>24</td>
<td>36</td>
<td>48</td>
</tr>
<tr>
<td><strong>Maximum Water Flow (GPM)</strong></td>
<td>40</td>
<td>40</td>
<td>60</td>
<td>80</td>
</tr>
</tbody>
</table>

The following primary/secondary piping design guidelines should be used for AM Series potable water applications. A 20-mesh strainer (or finer) is required at each inlet. Water flow rates and pressure drops shown below are for the primary loop. Flow rates vary with system design parameters. The water heater loop fittings and strainer pressure drops shown below are examples only - actual pressure drops will vary depending on actual piping layout and strainer size/type used.
### TABLE 4: Potable Applications

**MAXIMUM Potable Water Hardness = 10 grains per gallon**

**MAXIMUM Total Dissolved Solids = 200 ppm**

<table>
<thead>
<tr>
<th></th>
<th>AM 399</th>
<th>AM 500</th>
<th>AM 750</th>
<th>AM 1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Flow (GPM)</td>
<td>22</td>
<td>24</td>
<td>36</td>
<td>48</td>
</tr>
<tr>
<td>Water Press. Drop (Ft. of Hd.) across AM Series</td>
<td>10</td>
<td>14</td>
<td>14</td>
<td>17</td>
</tr>
<tr>
<td>Strainer $\Delta P$ (Ft. of Hd.) – (&quot;Y&quot; Strainer, 20 mesh) plus $\Delta P$ (Ft. of Hd.) – (20' SCH.40, 4 x 90°, 2 x reducing couplings, 2 x Ball Valve)</td>
<td>2.15</td>
<td>2.15</td>
<td>1.65</td>
<td>2.25</td>
</tr>
<tr>
<td><strong>Total Primary Loop $\Delta P$ (Ft. of Hd.)</strong></td>
<td>12.15</td>
<td>16.15</td>
<td>15.65</td>
<td>19.25</td>
</tr>
<tr>
<td>Recommended AERCO Pump+Circuit Setter Kit for piping configurations not exceeding the above example</td>
<td>99237-1</td>
<td>99237-2</td>
<td>99237-2</td>
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<td>2&quot;</td>
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<tr>
<td>Recommended AERCO AM DHW Installation Kit (Installation Kit already includes above Pump/Circuit setter kit, plus Strainer, Isolation Valve, and pipe fittings)</td>
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<td>58135-2</td>
<td>58135-3</td>
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<tr>
<td>Installation Kit designed for inlet/outlet piping diameter: Strainer and Isolation valves sizes (NPT):</td>
<td>1-1/2&quot;</td>
<td>2&quot;</td>
<td>2&quot;</td>
<td>2&quot;</td>
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**MAXIMUM Potable Water Hardness = 18 grains per gallon**

**MAXIMUM Total Dissolved Solids = 200 ppm**

<table>
<thead>
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<th></th>
<th>37</th>
<th>37</th>
<th>60</th>
<th>75</th>
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<td>Water Press. Drop (Ft. of Hd.) across AM Series</td>
<td>27</td>
<td>32</td>
<td>38</td>
<td>41</td>
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<tr>
<td>Strainer $\Delta P$ (Ft. of Hd.) – (&quot;Y&quot; Strainer, 20 mesh) plus $\Delta P$ (Ft. of Hd.) – (20' SCH.40, 4 x 90°, 2 x reducing couplings, 2 x Ball Valve)</td>
<td>1.88</td>
<td>1.88</td>
<td>2.20</td>
<td>3.05</td>
</tr>
<tr>
<td><strong>Total Primary Loop $\Delta P$ (Ft. of Hd.)</strong></td>
<td>28.88</td>
<td>33.88</td>
<td>40.20</td>
<td>44.05</td>
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<td>2&quot;</td>
<td>2-1/2&quot;</td>
<td>2-1/2&quot;</td>
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<td>58135-3</td>
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<tr>
<td>Installation Kit designed for inlet/outlet piping diameter: Strainer and Isolation valves sizes (NPT):</td>
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<td>2&quot;</td>
<td>2-1/2&quot;</td>
<td>2-1/2&quot;</td>
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**NOTE:**

Units with outlet connections matching pipe size do not include reducer.
2.4. PRIMARY PUMP

The primary pump shall have a discharge pressure able to assure the designed water flow rate, taking into account pressure drop losses as shown in Figure 2. When selecting a pump, take into account the pressure drop across the unit, fittings, accessories, and piping. The primary pump electrical connection shall be made as shown in Figure 4 for boilers and Figure 5 for water heaters (terminals 113 and 114).

Pumps shall be calculated by installers or engineers according to boiler and system parameters. The pump is not an integral part of the boiler.

Size your water system according to the following hardness guidelines to prevent scaling of the heat exchanger. See Figure 3 for corresponding water flow.

- If the water is 5 to 8 grain per gallon, this is SOFT water and you have to size the system for a 4 ft/sec minimum water velocity.
- If the water is 8 to 18 grain per gallon, this is NORMAL water and you have to size the system for a 4 to 8 ft/sec minimum water velocity.
- If the water is 18 to 23 grain per gallon, this is HARD water and you have to size the system for a 8 ft/sec minimum water velocity.

**NOTE:**
Select the pump flow rate so that the boiler water outlet temperature is 190°F (87.8°C) or below.

![Figure 2: Water Side Pressure Loss Chart](image-url)
Figure 3: Minimum/Maximum Water Flow in Relation to Water Hardness
Figure 4: AM BOILER: Electrical Connections
2.5. **STRAINERS**

AERCO requires the installation of a Y strainer to keep dirt out of the system and boiler. The strainer should be installed in the return piping with isolation valves to allow for cleaning as necessary. The Y strainer shall have a 20 mesh or finer strainer. Such filter shall protect the boiler from heating system dirt. It should be regularly cleaned to prevent problems.

2.6. **ISOLATION VALVES**

It is MANDATORY that ball or other type of shut-off valves be installed in the system supply and return piping to isolate the boiler if necessary. In this case the boiler can be disconnected or drained without having to drain the whole system.

**WARNING!**  
NEVER bypass safety devices, such as safety valves and expansion vessels.
2.7. AIR VENTING OF THE HEATING SYSTEM

The AM Series units come standard with automatic air vents on each of the headers on the rear of the unit (see Figure 6a and 6b). These vents are for the unit only and not the entire heating system. An effective air vent for air removal for the entire heating system must be installed in the highest point of the system piping.

Figure 6a: AM 399/500 Rear Panel Connections
Figure 6b: AM 750/1000 Rear Panel Connections

- Automatic Air Vents
- Safety Relief Valve
- Pressure and Temperature Gauge
- Header Temperature Sensor
- Water Supply (Outlet) Connection
- Headers
- Water Return (Inlet) Connection
- Draining Valves
2.8. LOW WATER CUTOFF (LWCO)

The low water cutoff (LWCO) is required (see Figure 7). This is shipped from AERCO. When installing such a device, you must consult and abide by all local codes and regulations in force.

*Figure 7: Low Water Cutoff (LWCO)*

**NOTE**

Use Teflon tape or a suitable pipe joint compound for component and piping connections.

2.9. MIXING VALVE

An anti-scald mixing valve is required on all AM Series Water Heaters. This valve is field supplied. When installing this valve, you must consult and abide by all local codes and regulations in force.
SEC 3: CONNECTIONS

3.1. PRIMARY-SECONDARY PIPING

Primary-secondary piping must be utilized. This can be accomplished by using a common pipe (see Figures 11, 13, 15, 17) or a hydraulic separator. Primary – secondary piping decouples the boiler loop from the system loop, making it independent from system loop pressure fluctuations associated with opening/closing of zone valves or 3-way valves.

3.2. SYSTEM FILLING AND DRAINING

The boiler is equipped with its own header drains (see Figures 6a and 6b for the drain locations). NEVER USE IT TO DRAIN THE ENTIRE SYSTEM, since the system dirt could gather in the boiler and compromise its operation. The system itself shall be equipped with its own drain, whose size will depend on the system capacity.

- For filling the system, a filling tap has to be inserted on the system return pipe.
- The filling can also be done through the draining tap on the boiler return manifold (see drain valve locations in Figure 6a and Figure 6b).
- In both cases, an approved hydraulic disconnection system has to be fitted.
- Before connecting the boiler, carefully rinse out the whole system, as specified in Section 2.3 or by local code and best practices.

3.3. CONDENSATE DRAIN

To maintain proper flow of condensate the drain pipe must have a slope toward the drain of at least 3/8 in./ft. (30 mm/m). In order to prevent ice from forming, the condensate piping must be well insulated.

Figure 8: Typical Condensate Drain Installation

A = Condensate drain pipe
B = Floor drain or drain pan
The AM Series of boilers and water heaters come equipped with a condensate trap and neutralizer tank (see Figure 9). It is crucial that these be filled with water to prevent combustion gases from entering the room and/or gases flowing backwards through the condensate line. A corrugated tube is provided to pipe neutralized condensate to a drain. It may be necessary to add additional piping to the condensate removal system in order to reach an appropriate drain.

**WARNING!**
The condensate collection box must be filled with water to prevent flue gas emissions from escaping during unit operation. Failure to comply with this requirement can result in dangerous levels of carbon monoxide and other dangerous gases.
SEC 4: PIPING DIAGRAMS

IMPORTANT PIPING NOTES!

- For actual sizes and locations of piping and other connections to the boiler, see appropriate dimensional drawing.
- Drain valve and condensate drain hose should be arranged to permit the fluids to drain freely by gravity to a convenient floor drain. The relief valve should be piped vertically to a height 18" above the floor.
- All piping and electric connections (service switches, conduit boxes, etc.) should be 6" away from side panels.
- **Mandatory**: primary pump
- **Mandatory**: boiler strainer (20 mesh or finer).
- Recommended: Gas regulator (and is **required** when supply pressure is greater than 13" W.C.)
- All drawings are of typical installations. Local codes and authorities should be consulted.
Figure 10: AM 399/500 Single Unit Installation
Figure 11: AM Series 399/500 Single Unit Installation with DHW Installed
Figure 12: AM Series 399/500 Multiple Unit Installation
Figure 13: AM Series 399/500 Multiple unit Installation with DHW Installed

(Reference SD-A-1001 rev D)
Figure 14: AM 750/1000 Single Unit Installation

(Reference SD-A-1002 rev C)
Figure 15: AM Series 750/1000 Single Unit Installation with DHW Installed
Figure 16: AM Series 750/1000 Multiple Unit Installation
Figure 17: AM Series 750/1000 Multiple unit Installation with DHW Installed

(Reference SD-A-1005 rev D)
Figure 18: AM Series 750R/1000R, Single Unit Installation with Optional Scale Reducer
Figure 19: AM Series 399R/500R, Single Unit Installation
Figure 20: AM Series 750R/1000R, Multiple Unit Installation with Optional Scale Reducer
Figure 21: AM Series 399R/500R, Multiple Unit Installation
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<td><strong>Rev C</strong>: Updated to support AM Series Rapid Recovery models. Added new bullet to section 1 regarding use of Loctite when connecting piping.</td>
<td>Curtis Harvey</td>
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<tr>
<td>08/08/2017</td>
<td><strong>Rev D</strong>: DIR 17-034: Reformatted per new design, updated and renumbered figures.</td>
<td>Chris Blair</td>
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<td>02/10/2020</td>
<td><strong>Rev E</strong>: Updated Boiler Loop Design Guidelines (2.3.4) and Potable Applications Primary Loop Design Guidelines (2.3.5).</td>
<td>Linley Thobourne</td>
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