Rinnai®

Technical Bulletin 87 Rev B- Damping Thermal Shock Events in Combined Space and Water Heating Systems

General Requirements:

Requirements for achieving satisfactory installation of Rinnai's Tankless Heating Systems are not more challenging than, nor distinctively different from, those requirements for a conventional hydronic heating system. This technical bulletin offers general recommendations to address thermal shock. The final requirements for any particular installation however, shall be specified by the engineer or the designer and shall adhere to methods outlined herein and to all national and/or local codes and ordinances having jurisdiction.

It is required that Tankless Water Heaters being employed in combined space and water heating systems are set at a minimum 140°F (60°C) supply water temperature; this is necessary to facilitate proper tempering of the effects of ground water temperatures (particularly when operating in cold climates).

Thermostatic Mixing Valve (TMV):

For reasons as stated above, all systems configured for combined space and water heating applications MUST be equipped with an approved thermostatic mixing valve (TMV) designed for anti-scald, anti-chill, and thermal shock defense. The TMV should have at least the following agency approval: ASSE 1017, CSA B125.3 and UPC (IAPMO) listed.

The recommended TMV temperature range for domestic hot water service shall be: 80°F - 120°F (27°C – 49°C).

⚠ WARNING	**Water temperature above 120°F (49° C) can cause serious injury. Mixing valve temperature setting should be done by licensed contractor per local code requirement. To ensure correct temperature control, use water thermometer at faucet outlet.**

Cause and Effect of Thermal Shock:

Thermal Shock is a term used to describe the flow, and pressure altering forces, often perceived as temperature flux, in combined space and water heating systems (Combos). The underlying cause of a thermal shock event is the changing system pressure under normal operation, which is made worse by anomalies in plumbing system designs and/or incorrect Combo system installation/commissioning.

From an operating standpoint, the system pressure change occurs when a valve is abruptly closed or during the start/stop sequence of the circulating pump. This in turn affects the Hot and Cold ports (of the thermostatic mixing valve) pressure differential which is specified by most manufacturers, not to exceed 10 psi.

When thermal shock occurs, a high intensity pressure wave travels back through the connecting piping, from the point of valve closure/impact, until it reaches a point of relief; such as a large diameter riser. If such a relief device does not exist, the shockwave (kinetic energy accompanied by a dangerous pressure rise in the system) will then surge back and forth between the hot side of the mixing valve and the point of impact until the energy is dissipated in the piping system. The preceding kinetic energy in turn influences the modulating response of both the tankless water heater's water flow sensor and valve, and the thermostatic mixing valve's thermostat element; thus, resulting in a temperature flux at the point of domestic hot water (DHW) use. Findings from recent lab testing also indicates that plumbing anomalies (such as undersized lines and/or incorrect piping configuration) can also cause a perceived thermal shock event.

Therefore, to mitigate said consequential temperature flux at the point of DHW use, the following steps MUST be followed as part of all combination space and water heating installation/ commissioning.

Using all three of the following steps (as outlined below) will significantly damper any thermal shock event (temperature flux) generated during normal system operation.

STEP 1:

A hydronic mode switch has been built into all current model tankless water heaters to facilitate combo functions. This mode must be activated when units are configured for combination space and water heating applications. To activate this mode, use the follow dip switch settings chart (Table 1). Note that Dip switch settings are model series specific.

TABLE 1: COMBINATION SPACE AND WATER HEATING DIP SWITCH MODE

Unit Models	Dip Switch Bank	Dip Switch #	Dip Switch Position
NON–CONDENSING SERIES			
RV53e (REU-VAM1620W-US) V53e (REU-VAM1620W-US)	DIPSW-1 (Yellow/Tan)	#1	ON
V94i (REU-VC2837FFU-US) V94Xi (REU-VC2737FFU-US) V94e (REU-VC2837W-US) V75i (REU-VC2528FFU-US) V75e (REU-VC2528W-US) V65i (REU-VC2025FFU-US) V65e (REU-VC2025W-US)		#7	ON
RL94i (REU-VC2837FFUD) RLX94i (REU-VC2737FFUD-US) RL94e (REU-VC2837WD-US) RL75i (REU-VC2528FFUD-US) RL75e (REU-VC2528WD-US)			
CONDENSING SERIES			
C199i (REU-KBD3237FFUDC-US) RUC98i (REU-KBD3237FFUD-US) RUC90i (REU-KBD2934FFUD-US) RUC80i (REU-KBD2530FFUD-US) RUR98i (REU-KBP3237FFUD-US RUCS75i (REU-KCM2528FFU-US) RUCS65i (REU-KCM2025FFU-US) RU98i (REU-KB3237FFUD-US) RU80i (REU-KB2530FFUD-US) C199e (REU-KB3237WDC-US) RU98e (REU-KB3237WD-US) RU90e (REU-KB2934WD-US) RU80e (REU-KB2530WD-US) RUR98e (REU-KBP3237DW-US) RUS75e (REU-KCM2528W-US) RUS65e (REU-KCM2025W-US)	DIPSW-1 (Yellow/Tan)	#7	ON

STEP 2:
Refer to attached piping configuration drawings. The hydronic furnace return water line is to be hydraulically separated from the incoming ground water and the cold side of the thermostatic mixing valve. This step is necessary to prevent flow in the hydronic circuit from interfering with flow in the domestic cold water circuit. The use of a check valve (by others) in the position shown, will achieve the required hydraulic separation between the two circuits in question.

STEP 3:

The third and final required step is to employ one of the following devices (Thermal Shock Damping Manifold or Water Hammer Arrester) in accordance with the specifications on the attached drawings.

Piping Configuration:

Refer to Drawing SK-1: Thermal Shock Damping Manifold (TSDM)

Drawing SK-1 illustrates the first of two alternative methods to be used in Step 3. In this particular method a manifold (refer to detail No. 1 on drawing SK-1) is used and is placed downstream of the mixing valve (tempered water out) in the main domestic hot water supply line. The manifold is to be positioned vertically with the tempered water entering at the lowest port and exiting at the highest port. The manifold is to be a minimum twelve inches (12") in length with a diameter greater than or equal to twice the main hot water line size. The Thermal Shock Damping Manifold (TSDM) must be field fabricated using appropriate piping material approved for potable water. The Thermal Shock Damping Manifold (TSDM) should be insulated with minimum R-4 piping insulation to minimize heat loss to the surrounding environment.

Refer to Drawing SK-2: Water Hammer Arrester

Drawing SK-2 illustrates the second alternate method. In this particular method a typical (off-the-shelf) water hammer arrester (refer to detail No. 2 on drawing SK-2) is used and is placed upstream of the mixing valve on the hot side. Specifically, water hammer arrester is to be located a minimum six inches below the hydronic furnace hot water supply connecting tee off the main hot water supply line but before the thermostatic mixing valve on the hot side.

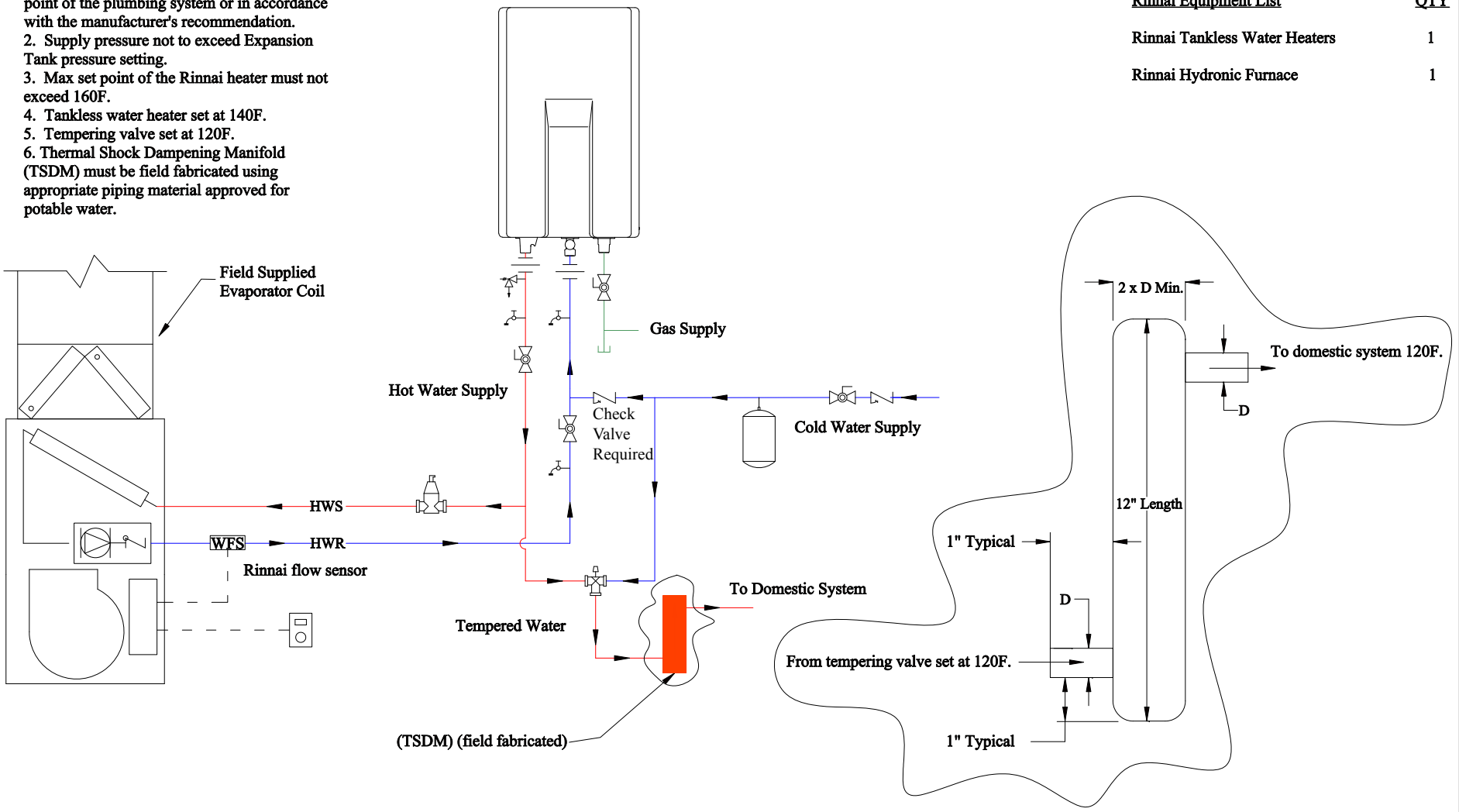
The Water Hammer Arrester to be sized in accordance to the respective manufacturer's sizing guidelines.

Rinnai Tankless
Single Unit with Hydronic Furnace

Notes:

1. Air Separator to be located at the highest point of the plumbing system or in accordance with the manufacturer's recommendation.
2. Supply pressure not to exceed Expansion Tank pressure setting.
3. Max set point of the Rinnai heater must not exceed 160F.
4. Tankless water heater set at 140F.
5. Tempering valve set at 120F.
6. Thermal Shock Dampening Manifold (TSDM) must be field fabricated using appropriate piping material approved for potable water.

Rinnai Equipment List	QTY
Rinnai Tankless Water Heaters	1
Rinnai Hydronic Furnace	1



This is not an engineering drawing; it is intended only as a guide and not as a replacement for professional engineering project drawings. This drawing is not intended to describe a complete system. It is up to the contractor or engineer to determine the necessary components and configuration of the particular system to be installed. The drawing does not imply compliance with local building code requirements. It is the responsibility of the engineer or contractor to ensure that the installation is in accordance with all local building codes. Confer with local building officials before installation.

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Tolerance
Fraction $=\pm\frac{1}{16}$"
x.x=±0.030
x.xx=±0.015
x.xxx=±0.005

Drawn By DRM
Approved By RS

Rinnai
Rinnai Tankless
Hydronic Furnace Detail 1

SIZE	SCALE	DWG NO.	REV
A	NTS	SK-1	D

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Rinnai Tankless
Single Unit with Hydronic Furnace

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Rinnai Tankless Water Heaters	1
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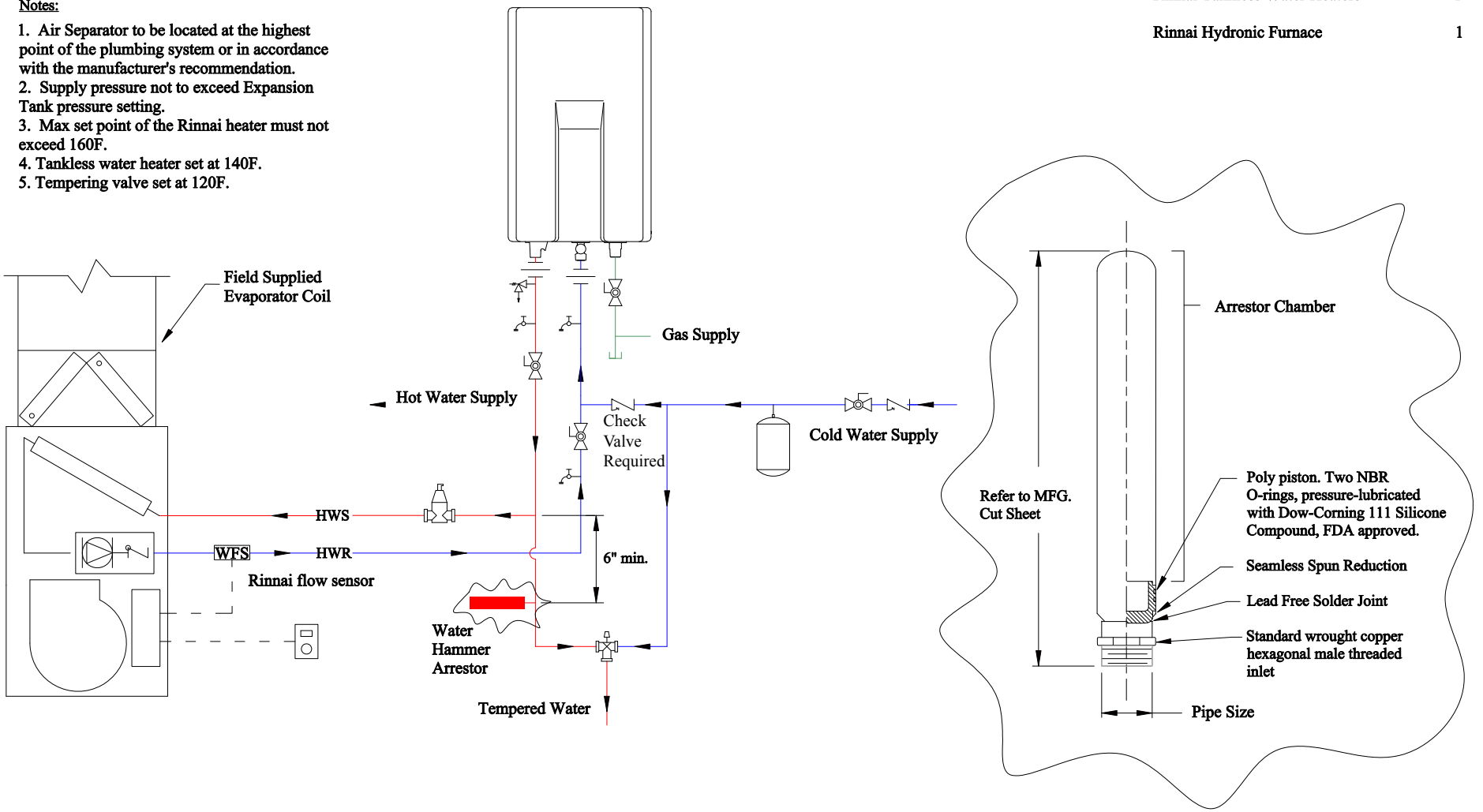

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Tolerance: Fraction $=\pm\frac{1}{16}''$, x.x=±0.030, x.xx=±0.015, x.xxx=±0.005

Drawn By: DRM
Approved By: RS

Rinnai

Rinnai Tankless
Hydronic Furnace Detail 2

SIZE	SCALE	DWG NO.	REV
A	NTS	SK-2	D

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