Rinnai

Commercial, Industrial & Domestic Continuous Flow Gas Hot Water Manual

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It will provide an excellent opportunity for hot water designers, professional engineers, qualified trades persons, TAFE teachers, students and other qualified persons to provide the latest hot water technology to the commercial, domestic and industrial market place.

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1

CHAPTER ONE

Introduction

1.1 Rinnai: 1920 to Beyond 2000

Rinnai Australia was established in 1971 and since then has been providing Australians with the best solutions to all of their gas appliance needs.

Rinnai Corporation, however, was founded over 70 years ago in Japan and has built up a marketing, sales and manufacturing network that spans the globe.

The Nagoya research and development plant employs approximately 465 people solely to develop and test new products. We are proud of the time and investment on research and development at Rinnai. The commitment to preserving the environment means that much of our R&D resource is channelled into the development of environment-friendly technology and products.

Our extensive research and development facility, and commitment to providing the most advanced products available, means that our continuous flow hot water systems are always at the leading edge of technology, safety, energy efficiency and quality.

This manual is designed as a reference to assist hot water system designers, professional engineers, qualified tradespersons, TAFE teachers, students and other suitably qualified persons, in the application, selection, design and sizing of hot water supply systems using Rinnai Continuous Flow water heaters.

Vision Statement

Create a perfect balance in living environments by identifying consumer needs and providing appliances and services that enhance lifestyles.

Mission Statement

Rinnai will be the leading supplier of lifestyle appliances and services to domestic and commercial markets that exceed the expectations of consumers, staff and other stakeholders.

Key Value Statement

We will conduct our business with honesty, integrity and act responsibly within the community.

Over 465 staff are dedicated to Research and Development in the Rinnai manufacturing facility in Japan.

Rinnai Australia has been in Australia since 1971.

2

CHAPTER TWO

Associations, Certifications, Sponsorships

Proudly a member of The Australian Gas Association. All of our products are AGA tested and certified.

Distributed and serviced in Australia under a Quality System certified as complying with ISO 9000 by SAI Global.

Rinnai New Zealand has been certified to ISO 9001 Quality Assurance by Telarc.

Certified to AS 3498 by SAI Global. Certification is awarded to products complying to safety and water contamination standards with suitable fittings.

Comparative Energy Consumption tested to The Australian Gas Association requirements of Australian Gas Code AG 102. An energy rating of 5 stars refers to an efficiency of approximately 80%, that is 80% of gas consumed is converted to useful heat.

The C-Tick Logo indicates compliance with the EMC requirements of the Australian Communications Authority.
Rinnai Australia Supplier No. N10378.

3

CHAPTER THREE

Types of Water Heating Systems

There are various types of water heating systems currently available. Some types store a volume of hot water ready for instant use, others heat water only when it is required. Control systems also vary, ranging from the older style thermo-mechanical types through to the advanced computer-based electronic control system used in the Rinnai V-Series Continuous Flow water heater range.

The most common types of water heater on the market today can be broadly described in the following categories:

- Continuous Flow (such as the Rinnai V Series)
- Instantaneous
- Storage.

3.1 Continuous Flow Gas Water Heaters

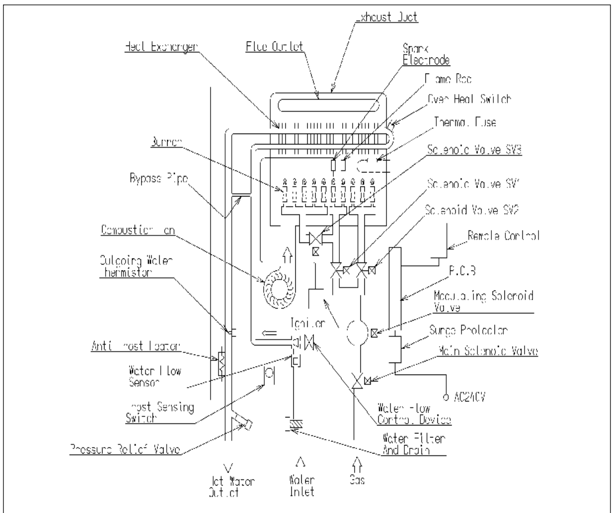


Figure 3.1: Continuous Flow Gas Water Heater

The main advantages of the Continuous Flow type water heater is that they can provide an endless supply of temperature controlled hot water. Continuous Flow water heaters only heat water while it is flowing, and the major components include a water flow sensor, modulating gas valve, and heat exchanger. Continuous Flow units use electronic ignition, eliminating the need for a pilot light (hence they require a 240 V connection). These units also feature electronic temperature control. They are the most compact of all water heaters.

The flow rate supplied from Continuous Flow units is very good. An entire household's hot water requirements can easily be met with the major benefit of never running out. Continuous Flow units can deliver a higher volume of water than instantaneous units due to a greater gas capacity of the burner. The flow rate supplied is determined by the temperature selected, incoming water temperature, outlet capacity and the water pressure supplied in the area.

The efficiency of the Continuous Flow units is a major benefit, simply because it heats water only when it is needed. There is no storage tank heating water unnecessarily for 24 hours per day. In commercial or industrial situations Continuous Flow units can be used in a manifold arrangement connected to a flow and return Hot Water system. These configurations can be adapted to suit every hot water requirement.
There are internal or external models available.

3.2 Instantaneous Water Heaters

Instantaneous water heaters also only heat water while it is flowing. Most Instantaneous water heaters are gas fired. In early models, the gas flow rate did not vary with the water flow resulting in quite poor water temperature control. Some later models include a thermo-mechanical thermostat which senses the water temperature to improve the temperature control.

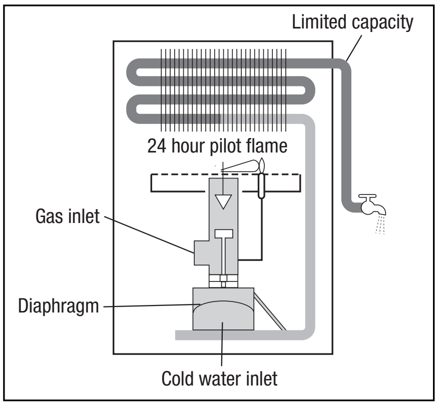


Figure 3.2: Instantaneous Water Heater

The major components of an Instantaneous water heater are a water-operated gas valve, and a finned-tube heat exchanger. In traditional gas Instantaneous water heaters, cold water flowing through the heater operates a mechanical valve which initiates gas flow to the main burner. The main burner is normally ignited from a continuously burning pilot, although some models are available which utilize electronic ignition. Hot combustion products flow up through the finned-tube heat exchanger to heat the flowing water.

The Instantaneous water heater can also provide an endless supply of hot water. They are, however, limited in the flow rate that they can deliver due to maximum gas consumption limitations, and the thermal efficiency of the unit. They also have poorer water temperature control compared with a Continuous Flow unit and greater pressure loss through the system.

3.3 Storage Water Heaters

Storage water heaters, as their name implies, store a volume of hot water which is kept hot ready to use. Cold water enters the storage cylinder near the base, and the hot water is drawn from the top.

Units which use either gas or electrical power to heat the water are available. Storage capacities currently range from 25 to 400 litres for domestic applications.

a) Gas Storage Water Heaters

In gas storage water heaters, a burner is normally located beneath the storage cylinder. Water is heated by hot products of combustion on the outside of the storage vessel. In some designs, the combustion products pass up through a central flue tube. In others the combustion products flow across the base and across some of the outside surface of the storage cylinder. Water is normally stored at or above 60°C.
Australian Standard AS 3500.4.2–1997 “National Plumbing and Drainage” Code, Clause 1.6:

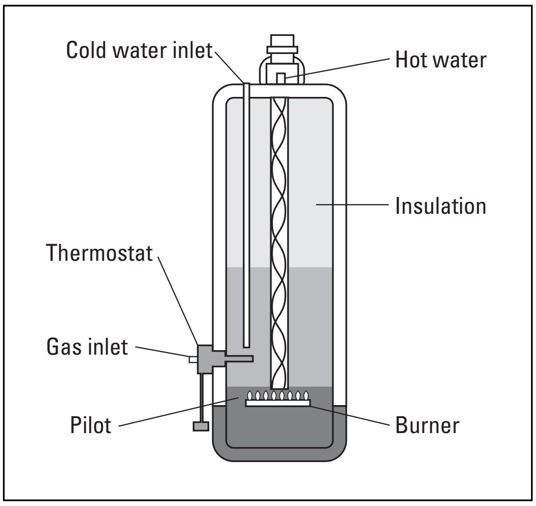


Figure 3.3: Gas Storage Water Heater

"Water Temperature" requires that water is stored at not less than 60°C to prevent growth of Legionella bacteria. The standard also requires that hot water is delivered to a domestic bathroom at not greater than 50°C. These units require the installation of an additional temperature control device, such as a tempering valve, to limit the maximum water temperature delivered to a bathroom.

Two major variations in storage cylinder construction exist in current designs:

- Mild steel storage cylinder lined with a protective layer of enamel. These units also include either one or two anodes inside the cylinder to provide further corrosion protection of the mild steel.
- Stainless steel storage cylinder — these units do not require enamel lining or the use of anodes.

Gas storage water heaters include a multi function gas valve located near the base of the cylinder which includes the following basic control features:

- Manual valve controlling gas flow to pilot and main burner.
- Manual piezo ignition of continuous pilot.
- Regulation of gas supply pressure to burner.
- Thermostatic control of stored water temperature—the temperature setting is adjustable at the water heater only.
- Thermoelectric flame failure valve to shut off gas supply in the event of flame outage.
- "One-shot" over-temperature fuse to shut off gas supply in the event that the water temperature exceeds 99°C.
- "One-shot" cut-out fuse to shut off gas supply in the event of flame roll out.

For domestic installations, units with storage volumes ranging from approximately 80 to 200 litres are typically used. Units are available for either indoor or outdoor installation.

A major advantage of storage water heaters is that they are able to supply hot water at high flow rates, and at reasonably constant temperature. The major disadvantage is that when the stored volume of hot water is used, they typically take around 30 to 90 minutes to re-heat fully, depending on their storage volume and gas rating. Also, the gas burner will ignite intermittently 24 hours a day, regardless if whether hot water is being used or not. High efficiency storage water heaters generally take longer to recover.

b) Electric Storage Water Heaters

Current design electric storage water heaters include either one or two electric elements which are immersed in the water. Older style units used an electric resistance element which was installed in a "dry well" (to prevent the element from coming into contact with water). In single-element models, the element is located near the base of the storage cylinder. In twin-element models, one is located near the base and the other towards the top. Water is normally stored at 60 to 75°C.

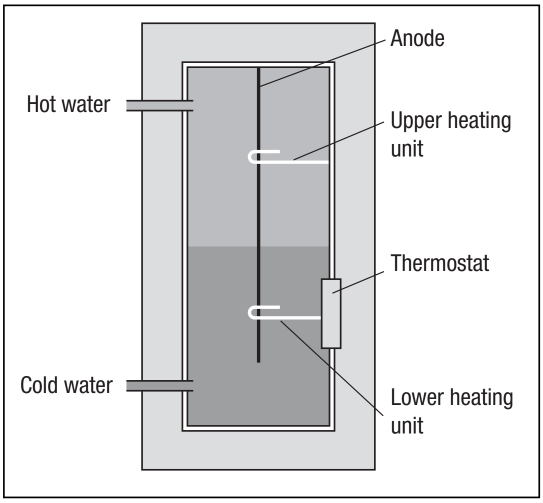


Figure 3.4: Electric Storage Water Heater

As with gas storage units, two major variations in storage cylinder construction exist in current designs:

- Mild steel storage cylinder lined with a protective layer of enamel. These units also include either one or two anodes inside the cylinder to provide further corrosion protection of the mild steel.
- Stainless steel storage cylinder — these units do not require enamel lining or the use of anodes.

Electric storage water heaters are fitted with a thermostat which controls the operation of the heating elements to maintain the required water temperature. In some cases the temperature setting is factory set, in others it is adjustable by the user between 60 and 75°C.

For domestic installations, units with storage volumes ranging from approximately 120 to 400 litres are typically used. For an equivalent hot water demand, a larger electric storage water heater would normally be installed. This is to allow for the significantly longer heat-up time of the electric units. Some electric units have a "booster" element installed near the top of the storage cylinder. This is intended to provide a smaller volume of hot water in a shorter time than is required to heat the whole cylinder. Units are available for either indoor or outdoor installation.

As is the case with gas storage water heaters, a major advantage is that electric storage units are able to supply hot water at high flow rates, and at reasonably constant temperature. The major disadvantage is that when the stored volume of hot water is used, they can take up to five hours to re-heat their full volume, or longer if operating on some off-peak tariffs which only allow re-heating overnight.

4

CHAPTER FOUR

Rinnai
Gas Continuous Flow Systems - V-Series

The Rinnai V-Series Continuous Flow range of water heaters utilizes the latest in water heating technology. Water is heated only while it is flowing, and therefore never runs out. They incorporate a high efficiency forced combustion system, and computer-based electronic ignition and control systems. The control system includes both feed forward and feedback control loops which provide accurate control of outlet water temperature. This temperature can be selected by the user to suit the specific end-use. Optional temperature control panels can adjust water temperature at up to four locations around the home such as the bathroom, ensuite, kitchen and laundry.

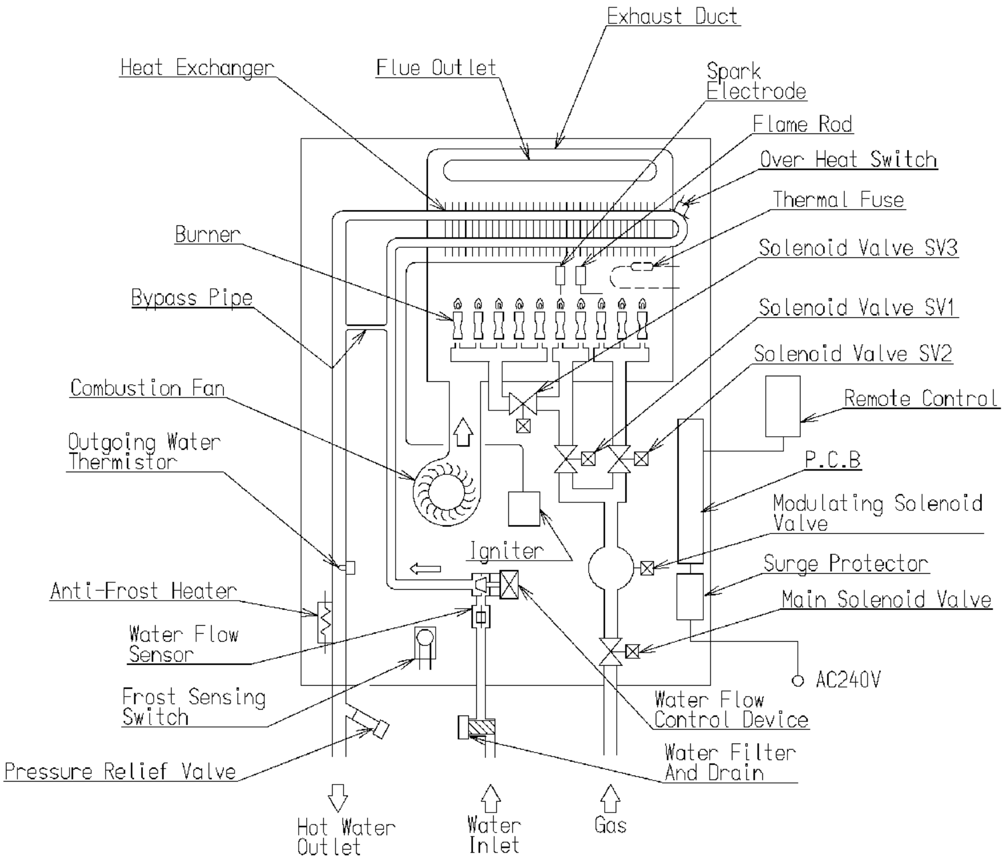


Figure 4.1: Internal components

4.1 Major Benefits

The major benefits provided by Rinnai V Series Continuous Flow water heaters are:

- Fingertip water temperature control.
- Endless hot water.
- Increased safety.
- High efficiency.
- Space saving, compact size.
- Delivers greater water flow rates than instantaneous models.
- Flexibility - can be used on its own or in conjunction with a storage tank, heat-exchanger etc.
- Economical operation
- Longevity

Some of these features are described in more detail below:

a) Remote Water Temperature Control

Controls are an optional extra. ‘Standard’ and ‘Deluxe’ controls can be fitted. Standard controllers allow temperature selection only. Deluxe controllers have temperature selection, bath-fill and voice prompting functions. For detailed information regarding controller operation refer to the ‘How to use your water heater’ booklet supplied with the appliance. Other Manufacturers’ controllers are NOT compatible with this appliance.

b) Endless Hot Water

The Rinnai V Series range of water heaters only heat water while it is flowing- as long as there is gas and electricity available, they never run out. The V-Series range can provide up to 1920 litres of hot water per hour (32 litres per minute) with a 25°C rise above ambient water temperature continuously - this significantly exceeds the supply capability of both storage and instantaneous water heaters.

c) Economical Operation

The Rinnai V Series range maintains its high thermal efficiency over a wider range of hot water usage loads than other types of water heaters. The units all use electronic ignition rather than a continuously burning pilot to ignite the burner.
The Rinnai V-Series Hot Water systems only heats water while it is flowing, so it only heats the water which is used. Standard storage water heaters, on the other hand, use energy to maintain the temperature of the stored water, even while it is not being used. This makes the V-Series economical for low and high demand applications. These efficiencies apply to both the Domestic and Commercial models.

Conventional storage and instantaneous water heaters supply water at high temperatures. This means that the pipework in the house is also very hot. With the user-adjustable temperature feature of the Rinnai V-Series range, the pipework in the house can be kept cooler, reducing heat losses and saving energy.

d) Space Saving, Compact Size

The smallest Rinnai V-Series unit measures approximately 350 mm wide x 530 mm high x 170 mm deep. This is much smaller than standard storage water heaters, it provides far greater installation flexibility, and requires much less floor or wall space around the home. Refer to Chapters 4.4 / 4.5 for more details on dimensions.

e) Longevity of the V-Series

The V-Series unit have a 10 year warranty on the heat exchanger and 3 years for parts and labour. Unlike storage tanks, there is no pressurized storage vessel to corrode and crack. The quality parts used ensure long life and peace of mind

For full warranty terms and conditions, please refer to Section 4.2.

Rinnai Hot Water - 8 reasons why…

1. Largest Capacities on the market
   Only Rinnai have both 26 & 32 litre models designed for multiple bathroom homes and large families.
2. Improved Flow rates
   Only Rinnai's innovative design provides the largest capacity flow rates giving all the hot water you need. They can also operate at very low flow rates (as low as 2.4 L/mins) which is beneficial for saving water.
3. Install up to 4 Controllers
   Only Rinnai allows installation of up to 4 controllers, even the laundry can now have hot water!
4. Highest Industry Star Rating
   Only Rinnai has units between 5.2 and 5.9 star ratings, with up to an impressive 87% thermal efficiency.
5. Standard Anti-frost
   Rinnai has an anti-frost feature on all external models, great for those cold mornings.
6. Environmentally Friendly
   Rinnai has introduced state of the art new low NOx burners for improved air quality. This is in addition to being a Gas appliance, which already produces approximately 70% less greenhouse emissions than electric Hot Water systems.
7. Extended 'domestic' warranty
   Rinnai has a 10 Year warranty on the heat exchanger and an extended warranty program to increase the Parts & Labour by 3 years to 5 years if you install 2 or more controllers.
8. Dedicated Commercial Range
   Only Rinnai has a dedicated Commercial Hot water range. Specially designed heat exchangers ensure a long-life in those hard working applications.
   Compare the Rinnai Hot Water Package!

4.2 Warranty

Warranty Terms are as follows:

Domestic Use	Heat Exchanger		All Other Parts	
	Parts	Labour	Parts	Labour
V-Series Product Range †	10 Years	3 Years	3 Years	3 Years

Commercial Use	Heat Exchanger		All Other Parts	
	Parts	Labour	Parts	Labour
V-Series Product Range †	1 Year	1 Year	1 Year	1 Year
Commercial Product Range # *	5 Years	1 Year	1 Year	1 Year

† Rinnai V-Series, REU-V1616W, V2020W, V2626W, V3232W, V2632FFU
* Rinnai V-Series, REU-V2632WC, V3232WC, V2632FFUC
# Water heaters preset to 85°C or 95°C ~ 1 Year Warranty on Heat Exchanger.

Note: All terms are effective from date of installation.

Faults arising from improper installation, gas supply, water quality exceeding recommended levels, plumbing fittings and other outside influences are not the responsibility of Rinnai Australia and service calls for these issues will be chargeable. For these warranty conditions to apply, water contaminants must be within the limits below:

Description	pH	TDS (Totally dissolved solids)	Total Hardness	Chlorides	Magnesium	Calcium	Sodium	Iron
Maximum Recommended Levels	6.5 to 9	Up to 600 mg/litre	Up to 200 mg/litre	Up to 300 mg/litre	Up to 10 mg/litre	Up to 20 mg/litre	Up to 150 mg/litre	Up to 1 mg/litre

Definition of Domestic Use:

The warranty periods that are allocated under “Domestic Use” are based on a hot water usage pattern of a typical family. Rinnai “Domestic Use” warranty periods also apply where Rinnai water heater(s) are installed in the following commercial installations at preset temperatures lower than 75°C and not incorporating storage cylinders and/or building flow and return systems: houses, apartments, townhouses, motel units, hotel rooms, caravans, mobile homes, nursing homes, retirement village complexes and other care institutions and like accommodation.

Definition of Commercial Use:

The warranty periods that are allocated under "Commercial Use" are for Rinnai water heater(s) installed at premises such as commercial and industrial buildings, cafes, caravan parks and sporting complexes. "Commercial Use" warranty also applies to:

- water heater(s) supplying central shower blocks.
- water heater(s) supplying kitchens used for the bulk preparation of food.
- water heater(s) set to 75° C or higher.
- water heater(s) used in commercial or industrial heating processes.
- Any application that uses Rinnai water heater(s) in conjunction with storage tanks and/or as part of a building flow and return system.
- water heater(s) installed as component(s) of centralised bulk hot water system(s).

The benefits conferred by this warranty are in addition to all other rights and remedies in respect of the product which you have under the Trade Practices Act and similar State or Territory Laws. Given installation is in accordance with the manufacturers specification, this appliance is warranted by Rinnai for the cost of labour and components in the event of defects arising from faulty materials and/or workmanship with the ensuing warranty conditions.

4.3 Safety Features

The 'point-of-use' water temperature adjustability provides a significant safety feature in that the hot water temperature can be controlled to help avoid scalding. This is particularly important with young children or the infirm.

A number of other safety features are also incorporated. These are:

a) Heat Exchanger Thermistor:

Measures hot water temperature at heat exchanger outlet. If water temperature reaches a predetermined limit, gas supply is stopped.

b) Hot Water Outlet Thermistor:

Measures hot water temperature at the water heater outlet.

c) Flame Rod:

Constantly monitors combustion characteristics inside the combustion chamber. If the flame fails or lifts, gas supply is stopped.

d) Over Heat Switch:

Situated on the heat exchanger, gas supply is stopped when water temperatures reaches a predetermined limit.

e) Fusible Link:

Situated on the heat exchanger, electrical power supply is stopped if the water (steam) temperature reaches a predetermined limit.

f) Water Pressure Relief Valve:

Opens at 2060 kPa and closes at 1470 kPa to safeguard the water circuit.

g) Electrical Fuse and Surge Protector:

3 Amp fuse and surge protector prevent against over current.

h) Boil Dry Prevention:

If water flow sensor detects no flow, gas supply is stopped.

i) Combustion Fan RPM Check:

In case of combustion fan defect, gas supply is stopped.

j) Temperature Cutout:

If the delivered hot water temperature is 3°C above the required delivery temperature for a couple of seconds, as sensed by the hot water outlet thermistor, the gas supply is stopped and will not re-open until the delivered hot water temperature reaches below the required delivery temperature. Not all continuous flow water heaters have this critical safety feature.

4.4 Hot Water Specifications

Table 4.1: Rinnai V-Series Specification summary

Model identification			Domestic External				Domestic Internal *
			REU-V1616W	REU-V2020W	REU-V2626W	REU-V3232W	REU-V2632FFU
Star rating			5.5	5.6	5.2	5.2	5.7
Installation			External	External	External	External	Internal
Gas Consumption MJ/h (Hi / Low)		NG	125/18	160/20	199/16	250/21	195/16
		LPG	125/18	160/21	199/16	250/21	195/16
Dimensions	mm	Width	350	350	350	470	350
		Height	530	530	600	600	600
		Depth	170	170	224	220	224
Weight	Kg		16	16	21	29	22
Water flow	L/min	*** min. (25°C) rise	2.4	2.4	2.4	2.4	2.4
		*** unmixed / mixed	16	20	26	32	^ 26
Anti-frost			Standard				Optional
Flue system	**(FF=Forced Flued)**		FF external				FF external
Default Temp. Settings	° C	**with remote**	**40, 43, 50, 55, 65, 75**		**40, 43, 50, 55, 60, 65, 75**		**40, 43, 50, 55, 60, 65, 75**
	° C	without remote	40, 43, 50, 55, 65, 75		40, 43, 50, 55, 60, 65, 75	40, 43, 50, 55, 60, 65, 75	40, 43, 50, 55, 60, 65, 75
Temp. range	° C		# 37 - 55 (Kitchen) 37 ~ 50 (Bathroom)				
Max. no. of Standard remote controllers			3		4		
Deluxe remote controllers		**Kitchen**	MC-91-1A		MC-91-1A or MC-70-2A		MC-91-1A or MC-70-2A
		Bathroom	MC-91-1A		MC-91-1A or BC-70-2A		MC-91-1A or BC-70-2A
		Second Bathroom	MC-91-1A		MC-91-1A or BC-70-2A		MC-91-1A or BC-70-2A
		Third Bathroom	N/A		MC-91-1A	N/A	MC-91-1A
Remote Controller Cable			Two core sheathed (double insulated) flex with minimum cross-sectional area of 0.5 mm²				
Burner system			Low NOx, Multi Stage				
Connections	gas supply		R 3/4 - 20A (right)		R 3/4 - 20A (right)		R 3/4 - 20A (right)
	cold water inlet		R 1/2 - 15A (centre)		R 3/4 - 20A (centre)		R 3/4 - 20A (centre)
	hot water inlet		R 1/2 - 15A (left)		R 3/4 - 20A (left)		R 3/4 - 20A (left)
Operating water pressure - min. for rated flow #			80 ~ 1000	130 ~ 1000	140 ~ 1000	180 ~ 1000	140 ~ 1000
Electrical consumption (Watts) Normal / Standby / Anti frost protection			47 / 6 / 74		65 / 6 100	83 / 12 / 100	80 / 7.5 / 100
Ignition system			Direct electronic ignition with automatic flame sensing (230 / 240 V)				
AGA Thermal Efficiency rating			80.4%	81.7%	82.0%	80.0%	86.6%
kW output			27.9	36.3	45.3	55.6	46.9
Power supply	appliance		AC 240 Volts 50 Hz (10 Ap power point required)				
	remote control		DC 12 Volts (Digital)				
Colour			Euro White				
Safety devices	flame failure		Flame Rod				
	boil dry		Water Flow Sensor				
	remaining flame (OHS)		97°C Bi-metal strip				
	over temp. (boiling)		95°C lookout thermistor				
	fusible link		129°C				
	pressure relief valve		Opens: 2060 kPa, Close: 1470 kPa				
	combustion fan rpm chk		Integrated circuit system				
	over current		Glass fuse (3 Amp)				

 # May operate at lower minimum pressures but rated Flow will not be achieved.

The V-Series can be installed as a storage booster, or loop situations of greater hot water demands.
Contact Rinnai for advice.
* Internal models require additional special Rinnai approved flueing.
^ Higher minimum flow rates up to 32 L/min. can be achieved if the temperature rise is less than 25° C.
# The Temperature ranges assume the water is limited to 55°C. This range will change for other water heater limit temperatures. Contact Rinnai for further details.

Rinnai reserves the right to modify specifications

Model identification			Commercial		Commercial Internal
			REU-V2632WC	REU-V3232WC	REU-V2632FFUC
Star rating			5.6	5.2	5.7
Installation			External	External	Internal
Gas Consumption MJ/h (Hi / Low)		NG LPG	199/16 199/16	250/21 250/21	195/16 195/16
Dimensions	mm	Width Height Depth	350 600 224	470 600 220	350 600 224
Weight	Kg		21	29	22
Water flow	L/min	*** min. (25°C) rise	2.4	2.4	2.4
		*** unmixed / mixed	^ 26	32	^ 26
Anti-frost			Standard		Optional
Flue system	**(FF=Forced Flued)**		FF external	FF external	FF internal
Default Temp. Settings	° C	**with remote**	**40, 43, 50, 55, 60, 65, 75**		
	° C	without remote	40, 43, 50, 55, 60, 65, 75, 85	40, 43, 50, 55, 60, 65, 75, 85, (95)	40, 43, 50, 55, 60, 65, 75, 85
Temp. range	° C		# 37 - 55 (Kitchen) 37 ~ 50 (Bathroom)		
Max. no. of Standard remote controllers			4	4	4
Deluxe remote controllers		**Kitchen**	MC-91-1A or MC-70-2A		
		Bathroom	MC-91-1A or BC-70-2A		
		Second Bathroom	MC-91-1A or BC-70-2A		
		Third Bathroom	MC-91-1A	N/A	MC-91-1A
Remote Control Cable			Two core sheathed (double insulated) flex with minimum cross-sectional area of 0.5 mm²		
Burner system			Low NOx, Multi Stage		
Connections	gas supply		R 3/4 - 20A (right)		
	cold water inlet		R 3/4 - 20A (centre)		
	hot water inlet		R 3/4 - 20A (left)		
Operating water pressure - min. for rated flow #			140 ~ 1000	180 ~ 1000	140 ~ 1000
Electrical consumption (Watts) Normal / Standby / Anti frost protection			65 / 6 / 100	83 / 12 / 100	80 / 7.5 / 100
Ignition System			Direct electronic ignition with automatic flame sensing (230 / 240 V)		
AGA Thermal Efficiency rating			85.4%	80.0%	86.6%
kW Output			47.2	56	46.9
Power supply	appliance		AC 240 Volts 50 Hz (10 Amp power point required)		
	remote control		DC 12 Volts (Digital)		
Colour			Euro White		
Safety devices		flame failure	Flame Rod		
		boil dry	Water flow sensor		
		remaining flame (OHS)	97°C Bi-metal strip		
		over temp. (boiling)	95°C lockout thermistor		
		fusible link	129°C		
		pressure relief valve	Opens: 2060 kPa, Close: 1470 kPa		
		combustion fan rpm chk	Integrated circuit system		
		over current	Glass fuse (3 Amp)		

 # May operate at lower minimum pressures but rated Flow will not be achieved.

* Internal models require additional special Rinnai approved flueing.
^ Higher minimum flow rates up to 32 L/min. can be achieved if the temperature rise is less than 25°C.
( ) only on Model V3232WC = **Conversion must be performed by Rinnai.**

The Temperature ranges assume the water is limited to 55°C. This range will change for other water heater limit temperatures. Contact Rinnai for further details.

Rinnai reserves the right to modify specifications

4.5 Rinnai V-Series Domestic Range

The Rinnai V Series range of water heaters are extremely compact. The following diagrams provide dimensions of each model. All dimensions are in millimeters.

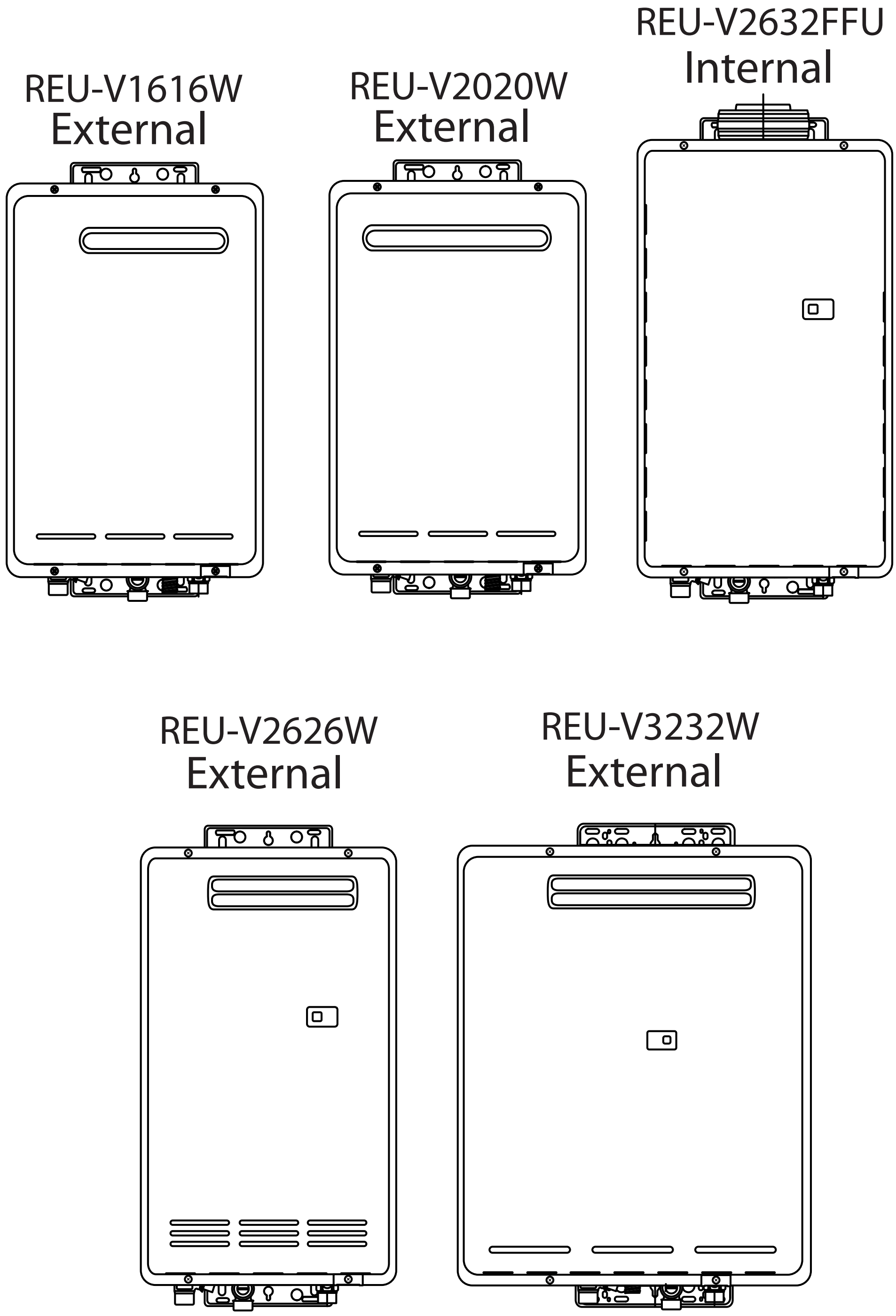
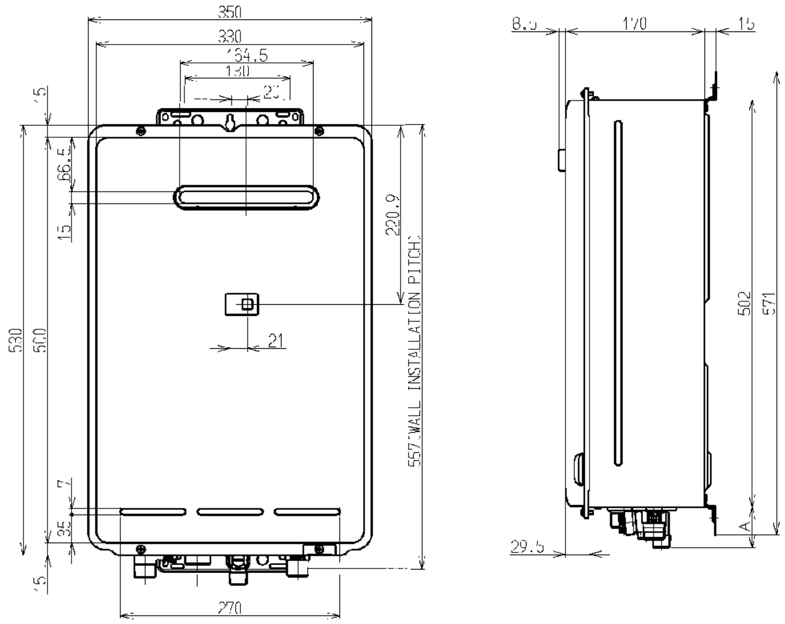
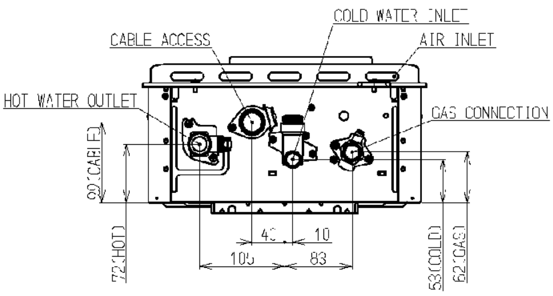


Figure 4.2: New V-Series Domestic Range

Rinnai V-Series: REU-V1616W



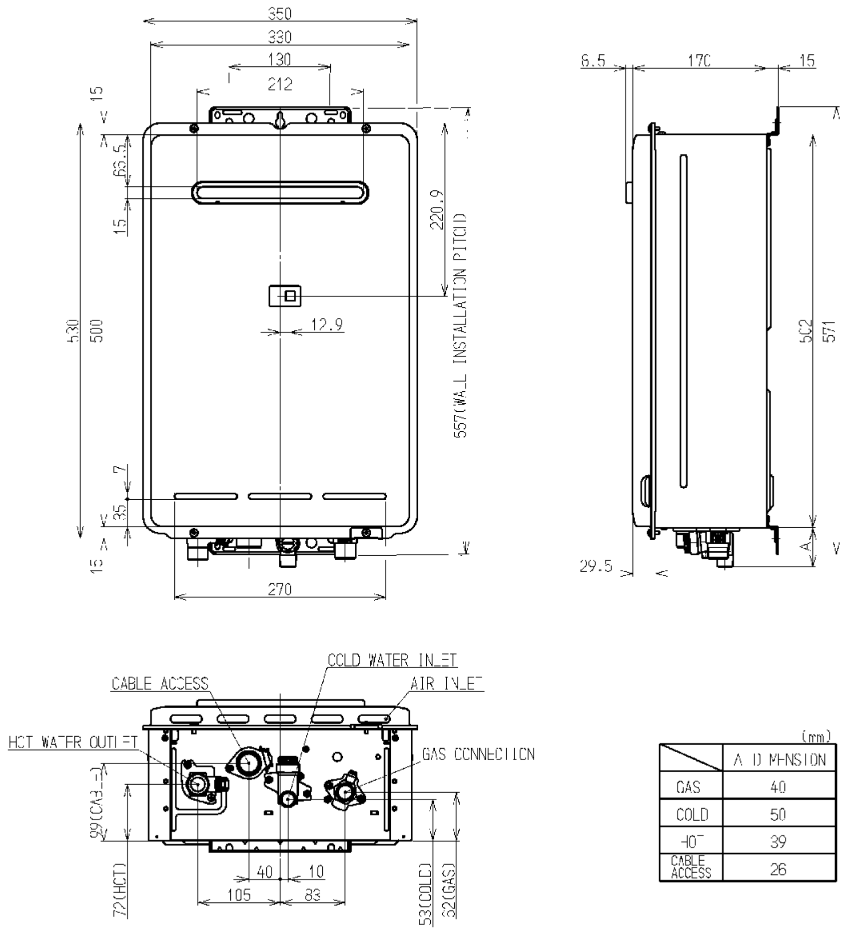


(mm)

	A DIMENSION
GAS	40
COLD	50
HOT	39
CABLE ACCESS	26

Figure 4.3: Dimensions of Rinnai V-Series: REU-V1616W

Rinnai V-Series: REU-V2020W

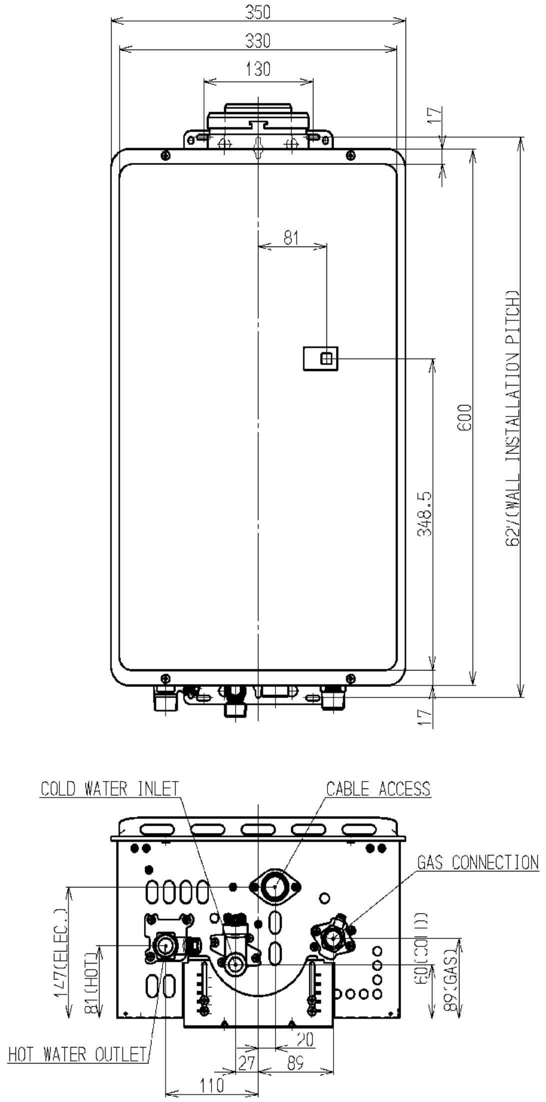


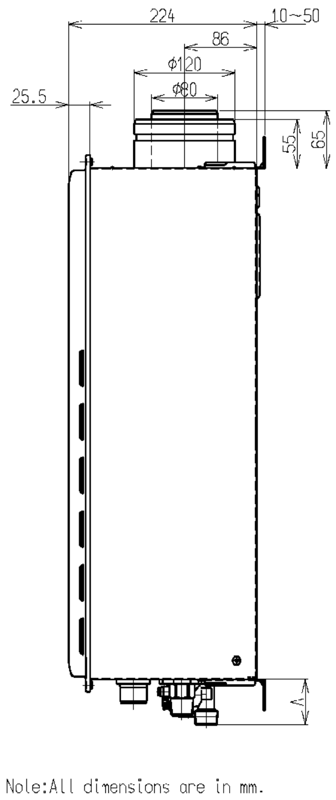
(mm)

	A DIMENSION
GAS	40
COLD	50
HOT	39
CABLE ACCESS	26

Figure 4.4: Dimensions of Rinnai V-Series: REU-V2020W

Rinnai V-Series: REU-V2632FFU





	A DIMENSION
GAS	4′
COLD	5′
HOT	42
ELEC.	27

Figure 4.5: Dimensions of Rinnai V-Series: REU-V2632FFU

Rinnai V-Series: REU-V2626W

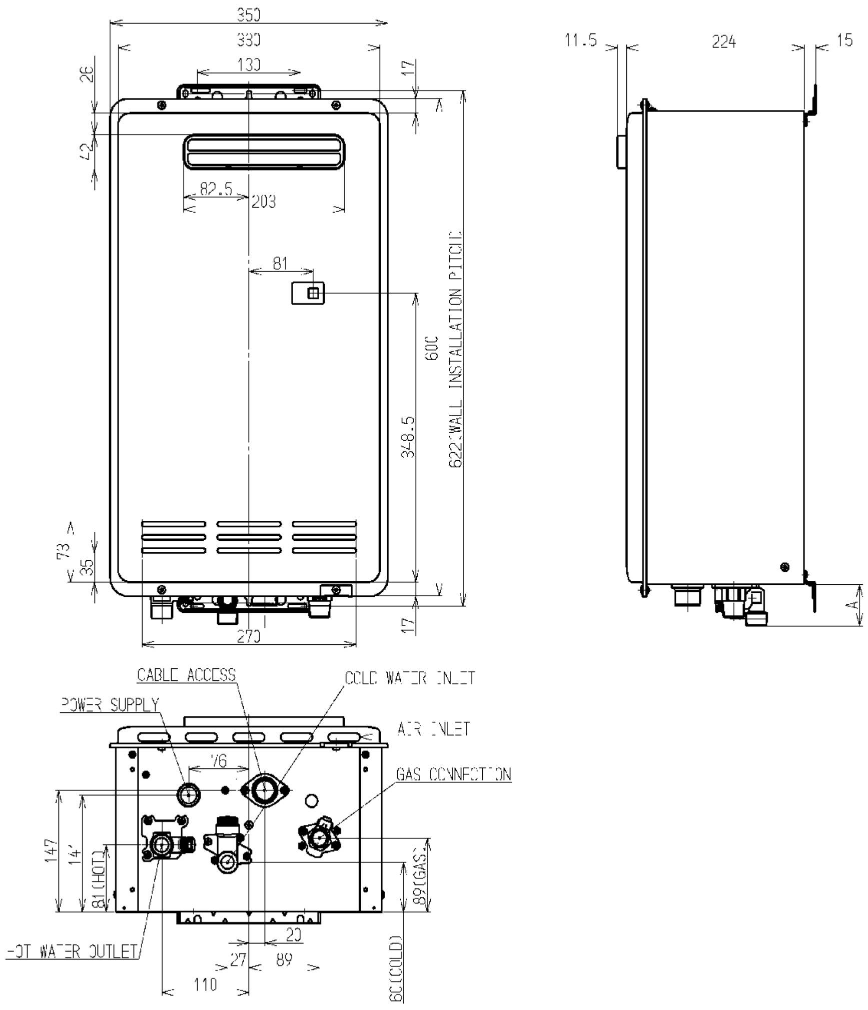
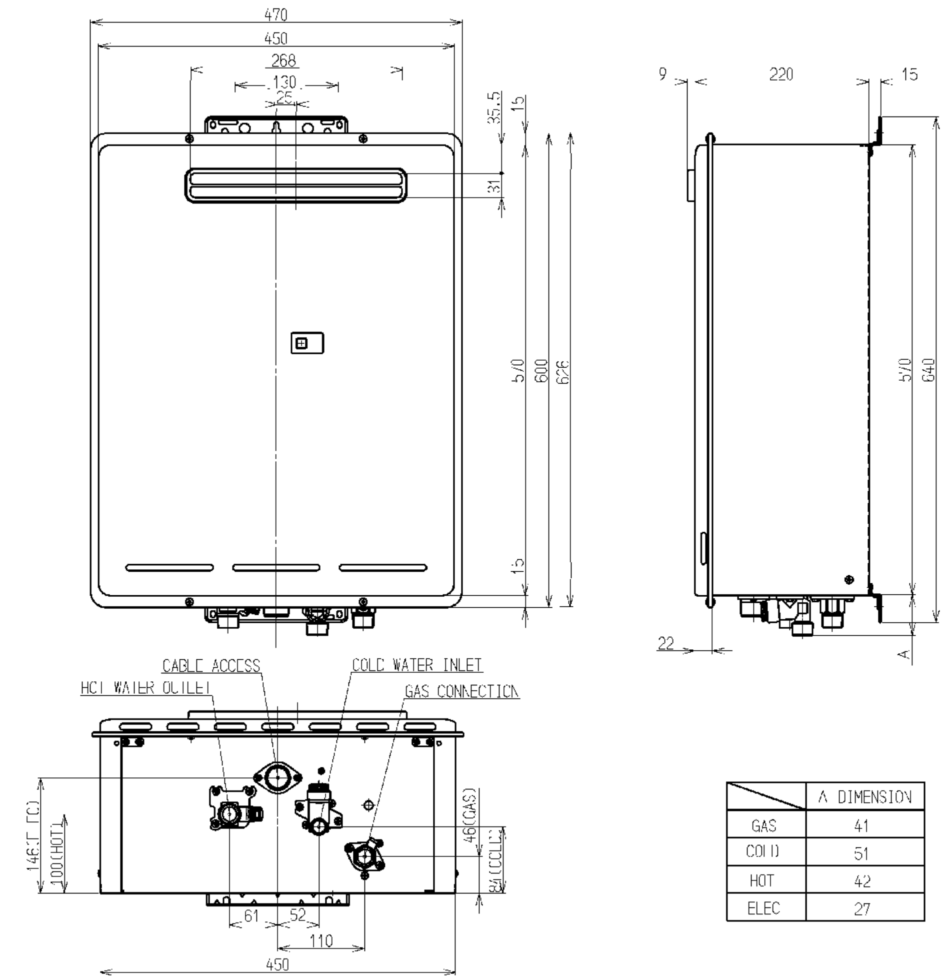


Figure 4.6: Dimensions of Rinnai V-Series: REU-V2626W

Rinnai V-Series: REU-V3232W



	A DIMENSION
GAS	41
COLD	51
HOT	42
ELEC	27

Note: Dimensions for the Commercial range units are on pages 67 -69

Figure 4.7: Dimensions of Rinnai V-Series: REU-V3232W

4.6 Location of Water Heaters

The information in this section is extracted from AS 5601/ AG 601–2002 Gas Installations. The Rinnai V-Series Hot Water heaters are fan assisted appliances,

Clearance Measurements for Vertical Flue Terminals

AS5601 / AG601-2002 Clause 5.13.6.2 Terminating a flue above a roof.

Where a flue is to terminate above -

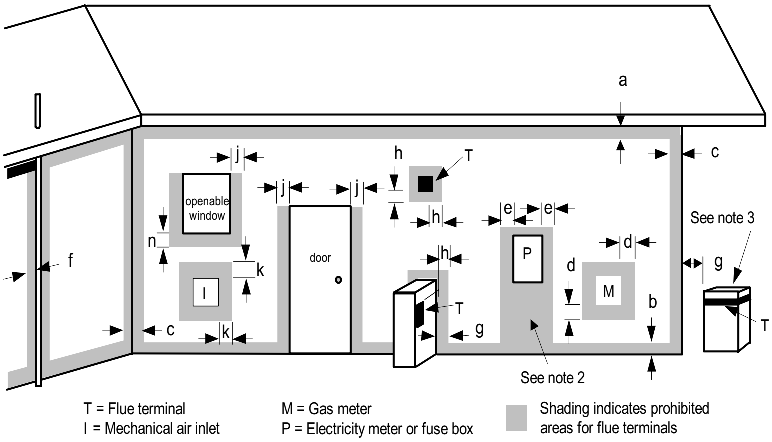
(a) a roof, the end of the flue shall be at least 500 mm from the nearest part of the roof;

(b) a trafficable roof designed for personal or public use, the end of the flue shall be at least 2 m above the roof level. This dimension is to be increased where necessary so that a minimum distance of 500 mm is maintained above any surrounding parapet; or

(c) a chimney, the end of the flue shall be at least 200 mm from the nearest part of the chimney

Clearance Measurements for Horizontal Flue Terminals

The clearance measurements in Figure 4.6 are reproduced from Fig. 5.3 in AS5601/AG601 - 2002.



Ref.	Item	Min. clearances (mm) Fan assisted
a	Below eaves, balconies and other projections:	
	• Appliances up to 50 MJ/h input	200
	• Appliances over 50 MJ/h input	300
b	From the ground, above a balcony or other surface †	300
c	From a return wall or external corner †	300
d	From a gas meter (M) (see 4.7.11 for vent terminal location of regulator)	1000
e	From an electricity meter or fuse box (P)	500
f	From a drain pipe or soil pipe	75
g	Horizontally from any building structure = or obstruction facing a terminal	500
h	From any other flue terminal, cowl, or combustion air intake †*	300
j	Horizontally from an openable window, door, non-mechanical air inlet, or any other opening into a building with the exception of sub-floor ventilation:	
	• Appliances up to 150 MJ/h input	300
	• Appliances over 150 MJ/h input up to 200 MJ/h input	500
	• Appliances over 200 MJ/h input	1500
	• All fan-assisted flue appliances, in the direction of discharge	1500
k	From a mechanical air inlet, including a spa blower	1000
n	Vertically below an openable window, non-mechanical air inlet, or any other opening into a building with the exception of sub-floor ventilation:	
	• Space heaters up to 50 MJ/h input	150
	• Other appliances up to 50 MJ/h input	500
	• Appliances over 50 MJ/h input and up to 150 MJ/h input	1000
	• Appliances over 150 MJ/h input	1500

† - unless appliance is approved for closer installation

NOTES:

1. All distances are measured to the nearest part of the terminal.
2. Prohibited area below electricity meter or fuse box extends to ground level.
3. See Clause 5.13.6.6 for restrictions on a flue terminal under a covered area.
4. See Appendix J, Figures J1(a) and J2(a), for clearances required from a flue terminal to an LP Gas cylinder. A flue terminal is considered to be a source of ignition.
5. For appliances not addressed above, approval shall be obtained from the Authority.

If in doubt regarding installation clearances not indicated above, refer to AS 5601 / AG 601 - 2002, or the relevant local authority. Refer to Chapter 5 for Flueing details of internal V-Series water heaters.

Figure 4.8: Location of External Water Heaters

4.7 Temperature Control Panels

Remote temperature controllers are an optional extra. 'Standard' and 'Deluxe' controls can be fitted. Standard controls allow temperature selection only.

Deluxe controls have temperature selection, bath-fill and voice prompting functions.

For detailed information regarding controller operation refer to the 'How to use your water heater' booklet supplied with the appliance. Other manufacturers' controllers are NOT compatible with this appliance

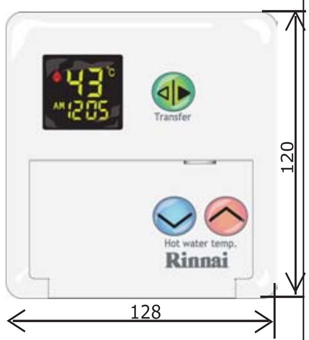
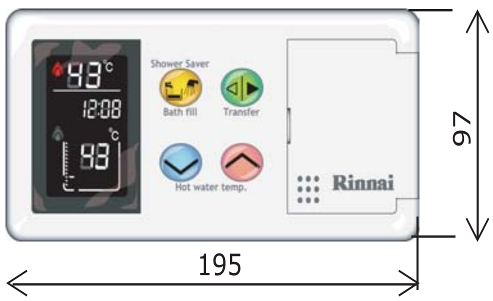
Kitchen MC-70-2A	Bathroom BC-70-2A	Ensuite/Second Bathroom BC-70-2A
		

Figure 4.9: Temperature Control Panels identification

Location of Temperature Control Panels

Temperature Control Panels must be installed in shaded and clean locations. They should be fitted out of reach of children (suggested height from floor at least 1500 mm). Controllers are water resistant, however, durability is improved when positioned outside the shower recess or at least 400 mm above the highest part of a sink, basin or bath.

DO NOT INSTALL THE CONTROL PANELS:

- Near a heat source, such as a cooktop, stove or oven. Heat, steam, smoke and hot oil may cause damage.
- In direct sunlight.
- Outdoors unless an enclosure is provided which protects the control panel against moisture, sunlight and dust ingress.
- Against a metal wall unless the wall is earthed in accordance with AS/NZS3000.

15 metres of remote control cable are supplied with these controller. Alternatively a two core sheathed flex with minimum cross-sectional area of 0.5 mm² can be used.

4.8 Tempered Water to areas for personal hygiene

AS3500 4.2:1997 Clause 1.6.2 states:

Sanitary fixtures delivery temperature. All new hot water installations shall, at the outlet of all sanitary fixtures used primarily for personal hygiene purposes deliver hot water not exceeding –

1. 45°C for early childhood centers, primary and secondary schools and nursing homes or similar facilities for young, aged, sick or disabled persons: and
2. 50°C in all other buildings.

Note: compliance with these temperature limits is optional for kitchen sinks and laundry tubs.

To meet this requirement the Rinnai V-Series hot water heaters can be preset to deliver water no hotter than 43°C or 50°C. Note: Using Temperature Controllers does not necessarily meet this requirement. Alternatively, the Rinnai V-Series hot water units can be set to a higher temperature with a tempering or thermostatic mixing valve fitted for warm water delivery to these areas. The various State Authorities have their own requirements for the provision of water to areas used primarily for personal hygiene. Consult your local authority for any specific requirements in the State or area where the system is to be installed.

If Tempering Valves are used to deliver water not exceeding 50°C, Rinnai recommend the RMC "Heatguard 15HP(15mm)" or "Heatguard 20HP (20mm)" or equivalent.

4.9 Water Flow, Water Pressures, Water Temperature and Gas Usage Tables

Water Flow, Water Pressures and Gas Usage Tables below show the relationship between these variables for all V-Series model water heaters at various water temperature rises. For Example: A REU-V2626W will deliver 26 Litres per minute at a temperature rise of 25° C. To achieve this it will consume 199 MJ/h of gas and will require a water inlet pressure of 200 kPa. (example shaded on table, refer Figure 4.10(a).

Models (All Pre-set Temperatures)	Temp Rise (° C) →	5					10					15					20				
	Approx. Min / Max Gas Input (MJ/hour)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)
REU-V1616W - Ext.	18-125 20-125	0.27	16	960	72	25	0.27	16	960	72	50	0.27	16	960	72	75	0.27	16	960	72	100
REU-V2020W - Ext.	21-160	0.33	20	1200	115	31	0.33	20	1200	115	62	0.33	20	1200	115	93	0.33	20	1200	115	124
REU-V2626W - Ext.	16-199	0.43	26	1560	200	40	0.43	26	1560	200	80	0.43	26	1560	200	120	0.43	26	1560	200	160

Models (All Pre-set Temperatures)	Temp Rise (° C)	25					30					35					40				
	Approx. Min / Max Gas Input (MJ/hour)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)
REU-V1616W	18-125 20-125	0.27	16	960	72	125	0.22	13.2	792	60	125	0.19	11.4	684	44	125	0.17	10.2	612	35	125
REU-V2020W	21-160	0.33	20	1200	115	155	0.29	17.4	1044	87	160	0.25	15	900	64	160	0.22	13.2	792	50	160
REU-V2626W	**16-199**	**0.43**	**26**	**1560**	**200**	**199**	0.36	21.6	1296	100	199	0.31	18.6	1116	70	199	0.27	16.2	972	50	199

Models (All Pre-set Temperatures)	Temp Rise (° C) →	45					50					55					60				
	Approx. Min / Max Gas Input (MJ/hour)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)
REU-V1616W	18-125 20-125	0.15	9	540	29	125	0.13	8	480	24	125	0.12	7.2	434	21	125	0.11	6.6	396	20	125
REU-V2020W	21-160	0.19	11.4	684	42	160	0.17	10.2	612	35	160	0.16	9.6	576	29	160	0.14	8.4	504	26	160
REU-V2626W	16-199	0.24	14.4	864	44	199	0.22	13.2	792	32	199	0.2	12	720	25	199	0.18	10.8	648	20	199

Figure 4.10(a): Water Flow, Water Pressures, Water Temperature and Gas Usage Table - REU-V1616W, REU-V2020W and REU-V2626W

Models (Preset temps *less than* 60 C)	Temp *Rise* (° C) →	5					10					15					20				
	Approx. Min / Max Gas Input (MJ/hour)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)
Rinnai HD200E (REU-V2632WC)	16-199	0.53	32	1920	140	47	0.53	32	1920	140	94	0.53	32	1920	140	141	0.53	32	1920	140	188
Rinnai HD200I (REU-V2632FFU-C) & REU-V2632FFU	16-195	0.53	32	1920	140	47	0.53	32	1920	140	94	0.53	32	1920	140	141	0.53	32	1920	140	188
Rinnai HD250E (REU-V3232WC) & REU-V3232W	21-250	0.53	32	1920	180	50	0.53	32	1920	180	100	0.53	32	1920	180	150	0.53	32	1920	180	200

Models (Preset temps *less than* 60 C)	Temp *Rise* (° C)	25					30					35					40				
	Approx. Min / Max Gas Input (MJ/hour)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)
Rinnai HD200E (REU-V2632WC)	16-199	0.44	26.4	1584	100	195	0.37	22.2	1332	65	199	0.32	19.2	1152	50	199	0.28	16.8	1008	40	199
Rinnai HD200I (REU-V2632FFU-C) & REU-V2632FFU	16-195	0.44	26.4	1584	100	195	0.37	22.2	1332	65	195	0.32	19.2	1152	50	195	0.28	16.8	1008	40	195
Rinnai HD250E (REU-V3232WC) & REU-V3232W	21-250	0.53	32	1920	180	250	0.44	26.4	1584	126	250	0.38	22.8	1368	95	250	0.33	19.8	1188	76	250

Models (Preset temps *less than* 60 C)	Temp *Rise* (° C) →	45					50					55					60				
	Approx. Min / Max Gas Input (MJ/hour)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)
Rinnai HD200E (REU-V2632WC)	16-199	0.25	15	900	30	199	0.22	13.2	792	25	199	0.2	12	720	23	199	0.19	11.4	684	20	199
Rinnai HD200I (REU-V2632FFU-C) & REU-V2632FFU	16-195	0.25	15	900	30	195	0.22	13.2	792	25	195	0.2	12	720	23	195	0.19	11.4	684	20	195
Rinnai HD250E (REU-V3232WC) & REU-V3232W	21-250	0.29	17.4	1044	60	250	0.26	15.6	936	50	244	0.24	14.4	864	43	244	0.22	13.2	792	37	250

Models (Preset temps *less than* 60 C)	Temp *Rise* (° C)	65					70					75					80				
	Approx. Min / Max Gas Input (MJ/hour)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)
Rinnai HD200E (REU-V2632WC)	16-199	0.17	10.2	612	19	199	0.16	9.6	576	18	199	0.15	9	540	17	199	0.14	8.4	504	16	199
Rinnai HD200I (REU-V2632FFU-C) & REU-V2632FFU	16-195	0.17	10.2	612	19	195	0.16	9.6	576	18	195	0.15	9	540	17	195	0.14	8.4	504	16	195
Rinnai HD250E (REU-V3232WC) & REU-V3232W	21-250	0.2	12	720	29	250	0.19	11.4	684	25	250	0.18	10.8	648	24	250	0.16	9.6	576	22	250

Figure 4.10(b): Water Flow, Water Pressures, Water Temperature and Gas Usage Table - REU-V2632W, REU-V2632FFU, REU-V2632WC, REU-V2632FFUC - Preset Temperature Less than 60° C.

Models (Preset temps *greater than or equal* to 60 C)	Temp *Rise* (° C) → / Approx. Min / Max Gas Input (MJ/hour)	5					10					15					20				
		L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)
Rinnai HD200E (REU-V2632WC)	16-199	0.4	24	1440	200	36	0.4	24	1440	200	72	0.4	24	1440	200	108	0.4	24	1440	200	144
Rinnai HD200I (REU-V2632FFU-C) & REU-V2632FFU	16-195	0.4	24	1440	200	36	0.4	24	1440	200	72	0.4	24	1440	200	108	0.4	24	1440	200	144
Rinnai HD250E (REU-V3232WC) & REU-V3232W	21-250	0.35	21	1260	138	33	0.35	21	1260	138	66	0.35	21	1260	138	99	0.35	21	1260	138	132

Models (Preset temps *greater than or equal* to 60 C)	Temp *Rise* (° C)	25					30					35					40				
		L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)
Rinnai HD200E (REU-V2632WC)	Approx. Min / Max Gas Input (MJ/hour)	0.4	24	1440	200	180	0.37	22.2	1332	112.5	199	0.32	19.2	1152	75	199	0.28	16.8	1008	60	199
Rinnai HD200I (REU-V2632FFU-C) & REU-V2632FFU	16-195	0.4	24	1440	200	180	0.37	22.2	1332	112.5	199	0.32	19.2	1152	75	199	0.28	16.8	1008	60	199
Rinnai HD250E (REU-V3232WC) & REU-V3232W	21-250	0.35	21	1260	138	165	0.35	21	1260	138	196	0.35	21	1260	138	229	0.33	19.8	1188	125	250

Models (Preset temps *greater than or equal* to 60 C)	Temp *Rise* (° C) → / Approx. Min / Max Gas Input (MJ/hour)	45					50					55					60				
		L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)
Rinnai HD200E (REU-V2632WC)	16-199	0.25	15	900	45	199	0.22	13.2	792	40	199	0.2	12	720	36	199	0.19	11.4	684	33	199
Rinnai HD200I (REU-V2632FFU-C) & REU-V2632FFU	16-195	0.25	15	900	45	195	0.22	13.2	792	40	195	0.2	12	720	36	195	0.19	11.4	684	33	195
Rinnai HD250E (REU-V3232WC) & REU-V3232W	21-250	0.3	18	1080	100	250	0.27	16.2	972	82	250	0.24	14.4	864	68	250	0.22	13.2	792	58	250

Models (Preset temps *greater than or equal* to 60 C)	Temp *Rise* (° C) / Approx. Min / Max Gas Input (MJ/hour)	65					70					75					80				
		L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)
Rinnai HD200E (REU-V2632WC)	16-199	0.17	10.2	612	31	199	0.16	9.6	576	29	199	0.15	9	540	27	199	0.14	8.4	504	25	199
Rinnai HD200I (REU-V2632FFU-C) & REU-V2632FFU	16-195	0.17	10.2	612	31	195	0.16	9.6	576	29	195	0.15	9	540	27	195	0.14	8.4	504	25	195
Rinnai HD250E (REU-V3232WC) & REU-V3232W	21-250	0.2	12	720	50	250	0.19	11.4	684	47	250	0.18	10.8	648	39	250	0.17	10	600	33	250

Models (Preset temps *greater than or equal* to 60 C)	Temp *Rise* (° C) → / Approx. Min / Max Gas Input (MJ/hour)	85					90				
		L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)	L/sec	L/min	L/hr	Min Water Pressure (kPa)	Approx Gas Cons. (MJ/h)
Rinnai HD250E (REU-V3232WC)	21-250	0.16	9.6	576	29	250	0.15	9	540	25	250

Notes:

1. All values shown are approximate.
2. Temperature ***Rise*** = Pre-set temperature of water heater - Incoming Water Temp.
3. Minimum Water pressures quoted are for flow through the water heater only.

Figure:4.10(c)Water Flow, Water Pressure, Water Temperature and Gas Usage Table - REU-V2632W, REU-V2632FFU, REU-V2632WC, REU-V2632FFUC - Preset Temperature greater than or equal to 60° C.

4.10 Water Pressures and Flow Characteristics

The pressure loss through the V-Series hot water heater range is due to the friction generated when water flows through the heat exchanger and associated components. These pressure losses must be taken into consideration during installation.

The pressure loss characteristics of the Rinnai V-Series are shown in Figures 4.11.

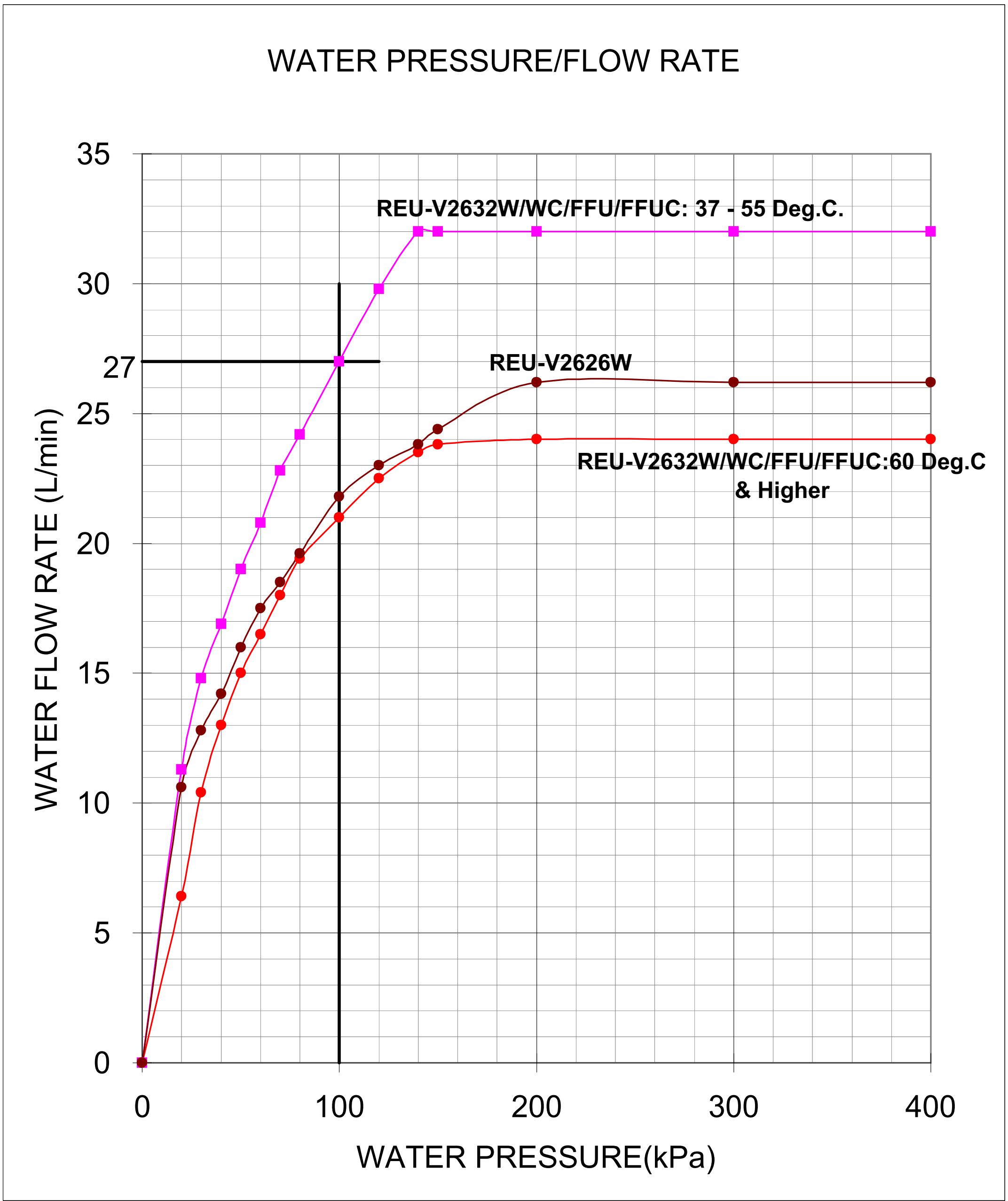


Figure 4.11(a): Pressure Loss vs Flow (V-Series REU-V2626W / REU-V2632W / REU-V2632FFU / REU-V2632WC / REU-V2632FFUC).

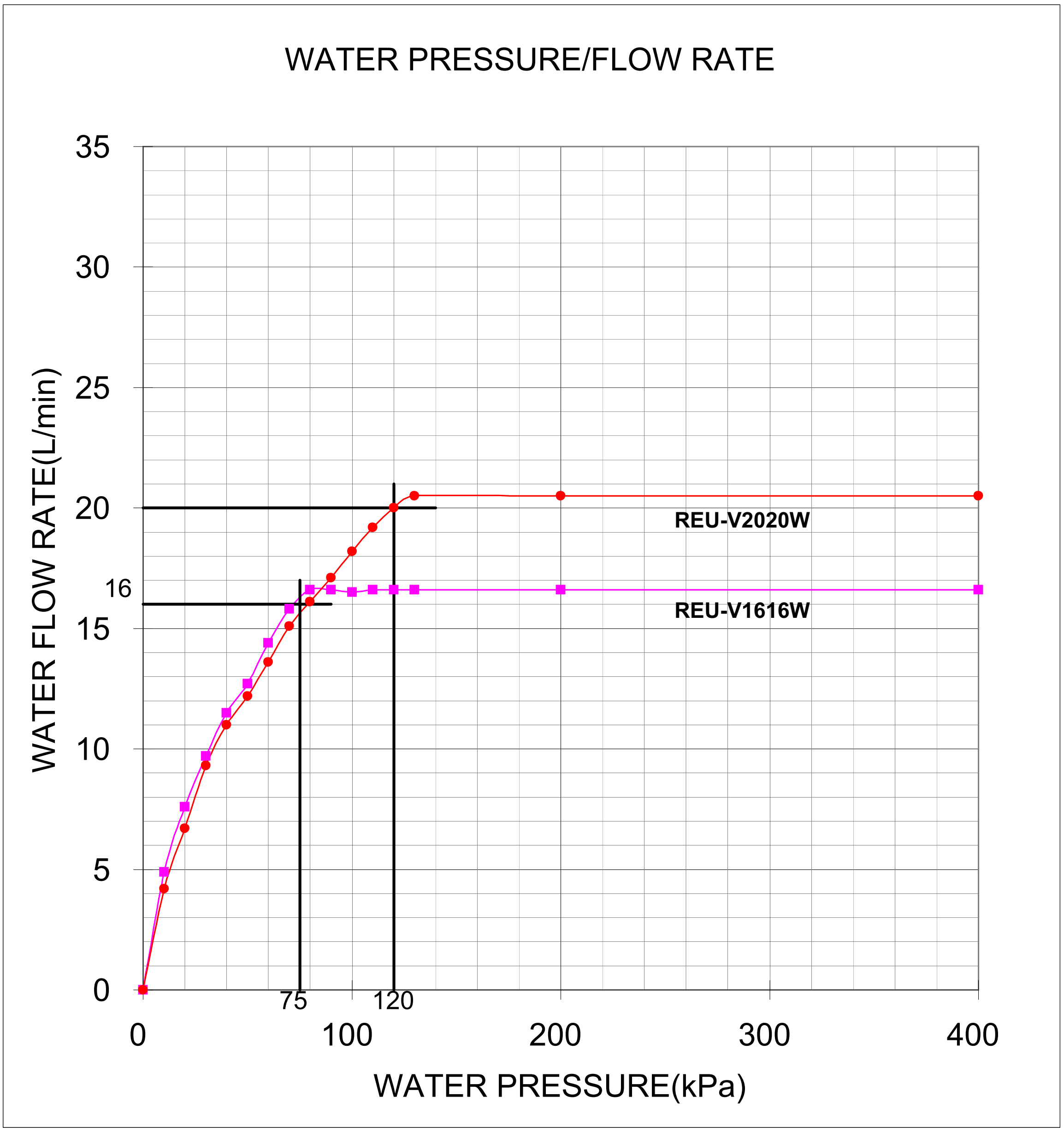


Figure 4.11(b): Pressure Loss vs Flow (V Series REU-V1616W/REU-V2020W)

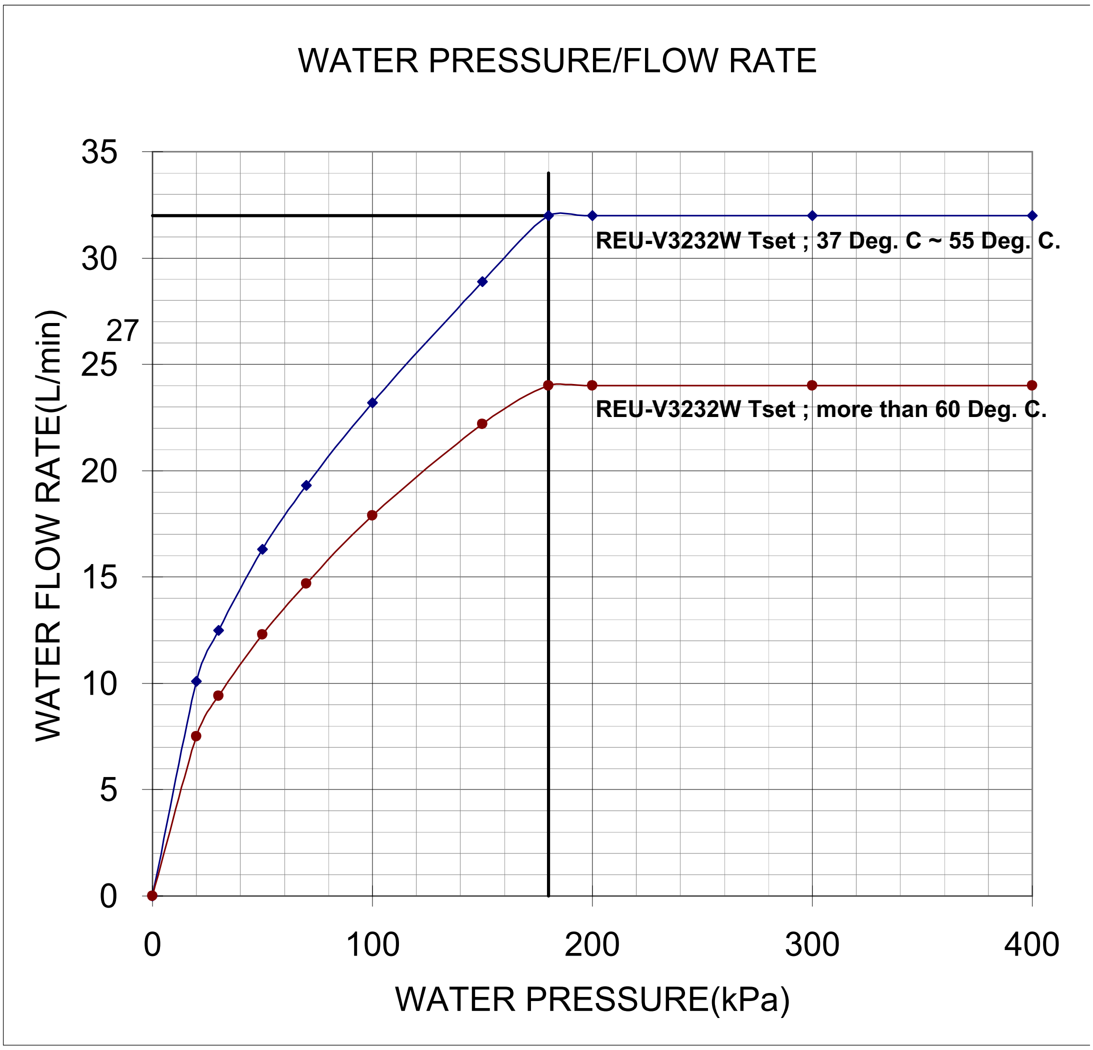


Figure 4.11(c): Pressure Loss vs Flow (V Series REU-V3232W / REU-V3232WC)

5

CHAPTER FIVE

Flueing

5. Flueing

5.1 Safety Features

The Gas Installation Code AS 5601 / AG 601–2002 sets out the requirements for flueing and ventilation of gas fired appliances.

5.2 Basic Principles

Proper flueing of appliances ensures that:

- Combustion gases are conveyed to an external point of discharge.
- The building is protected from fire hazards.
- Condensation of water vapour is minimized.

5.3 Flueing for Individual Room Sealed V-Series (FFU range)

The V-Series FFU range water heaters are type 1 room sealed appliances and fan assisted as per AS4552 / AG102 - 2000. This means that the water heater is sealed from the room in which it is installed so that it directly discharges combustion products to, and takes air from, outside the building via a Co-axial flue system designed and approved specifically for use with V-Series FFU range hot water heaters.

Other commercially available flue systems are NOT approved for use with this range of hot water heaters.

The flue terminal clearances in Figure 5.3 of AS5601 / AG601 apply unless stated otherwise in this section. This figure is reproduced in Section 4.6. Detailed Flueing installation instructions are supplied with flue terminals. Detailed Appliance installation instructions are supplied with the water heater. There are 4 methods for flueing FFU water heaters (see below).

1. Direct Flueing with Wall Terminal (FFU models)

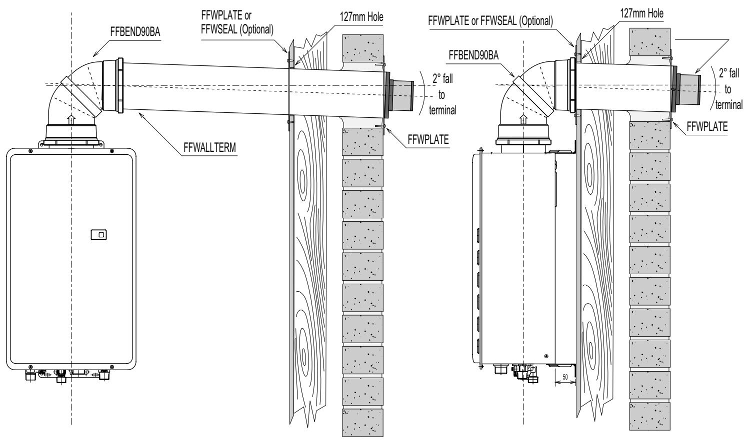


Figure 5.1: Direct Flueing with Wall Terminal (FFU models)

2. Horizontal Extension Flueing with Wall Terminal (FFU models)

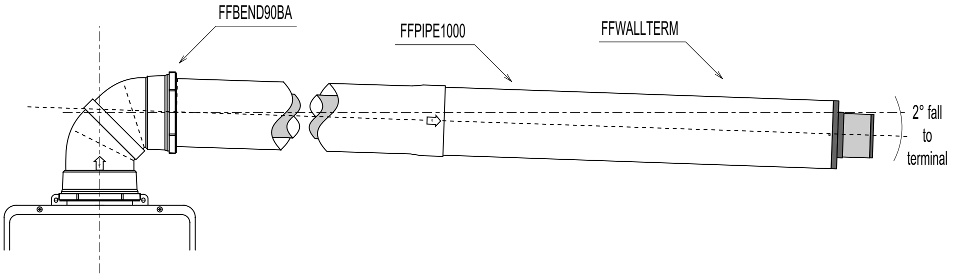


Figure 5.2: Horizontal Extension Flueing with Wall Terminal (FFU models)

3. Vertical Flueing with Roof Terminal (FFU models)

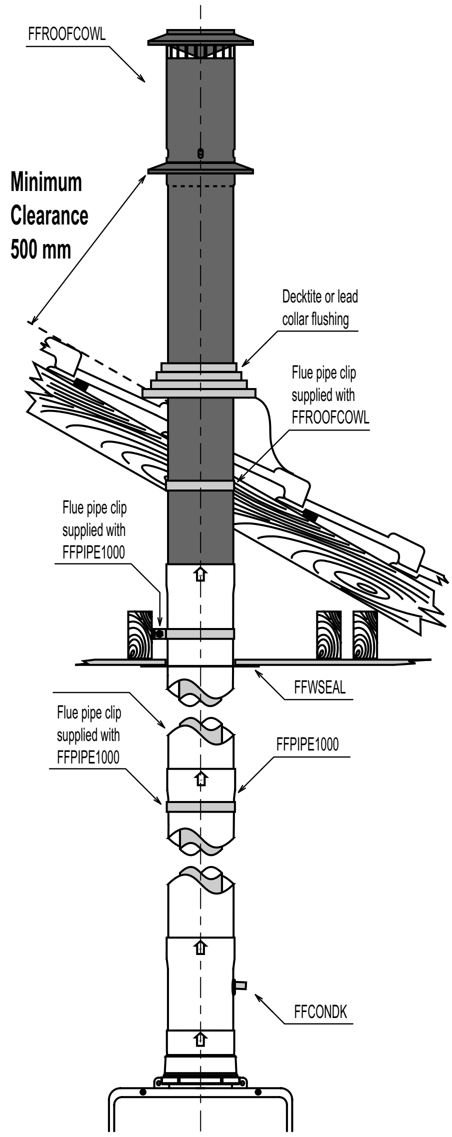


Figure 5.3: Vertical Flueing with Room Terminal (FFU models)

4. Combination vertical / horizontal Flueing with bends and wall or roof terminal (FFU models).

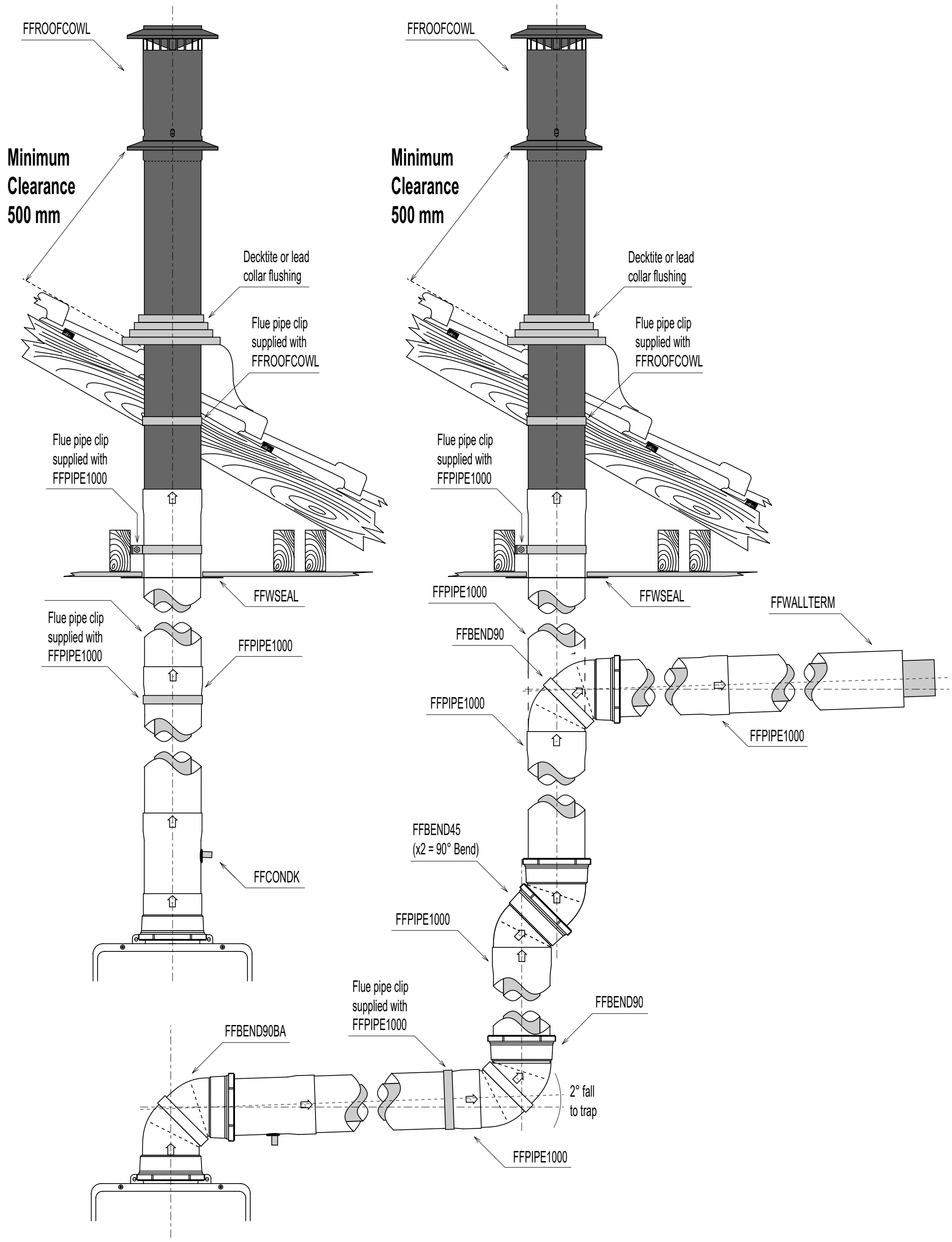


Figure 5.4: Combination Vertical / Horizontal Flueing (FFU models).

5.4 Flueing for Multiple Room Sealed V-Series models (FFU models)

The Room Sealed V-Series water heaters are AGA Approved to be installed side by side as shown below allowing for a horizontal distance of 160 mm between vertical flue terminals and 270 mm between horizontal terminals and dimension 'h' on Figure 5.3 of AS5601/AG601 - 2002 does not apply. These type of installations are subject to the approval of your local authority.

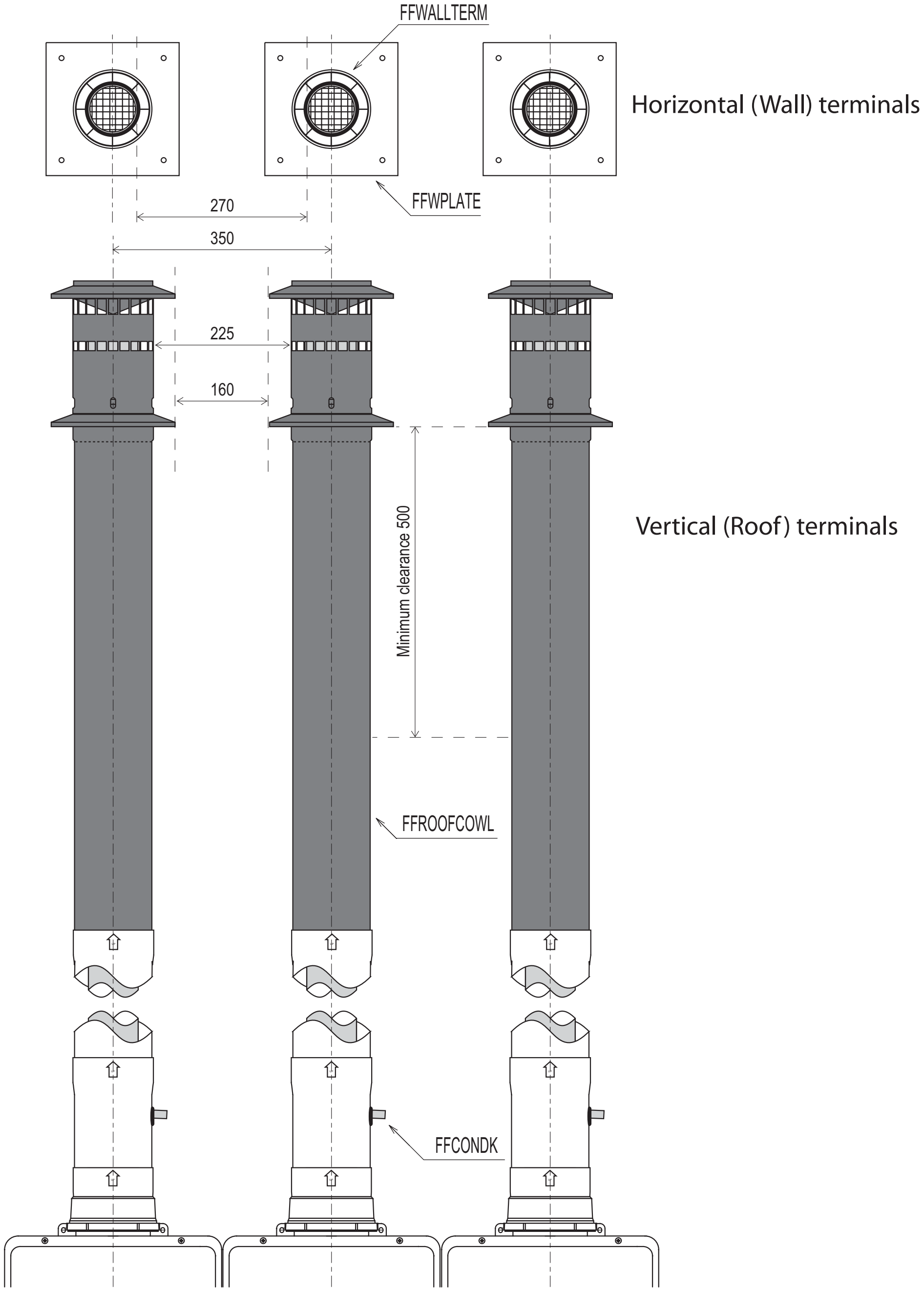


Figure 5.5: Flueing for Multiple Room Sealed V-Series models (FFU models).

5.5 Flueing Componentry (FFU range)

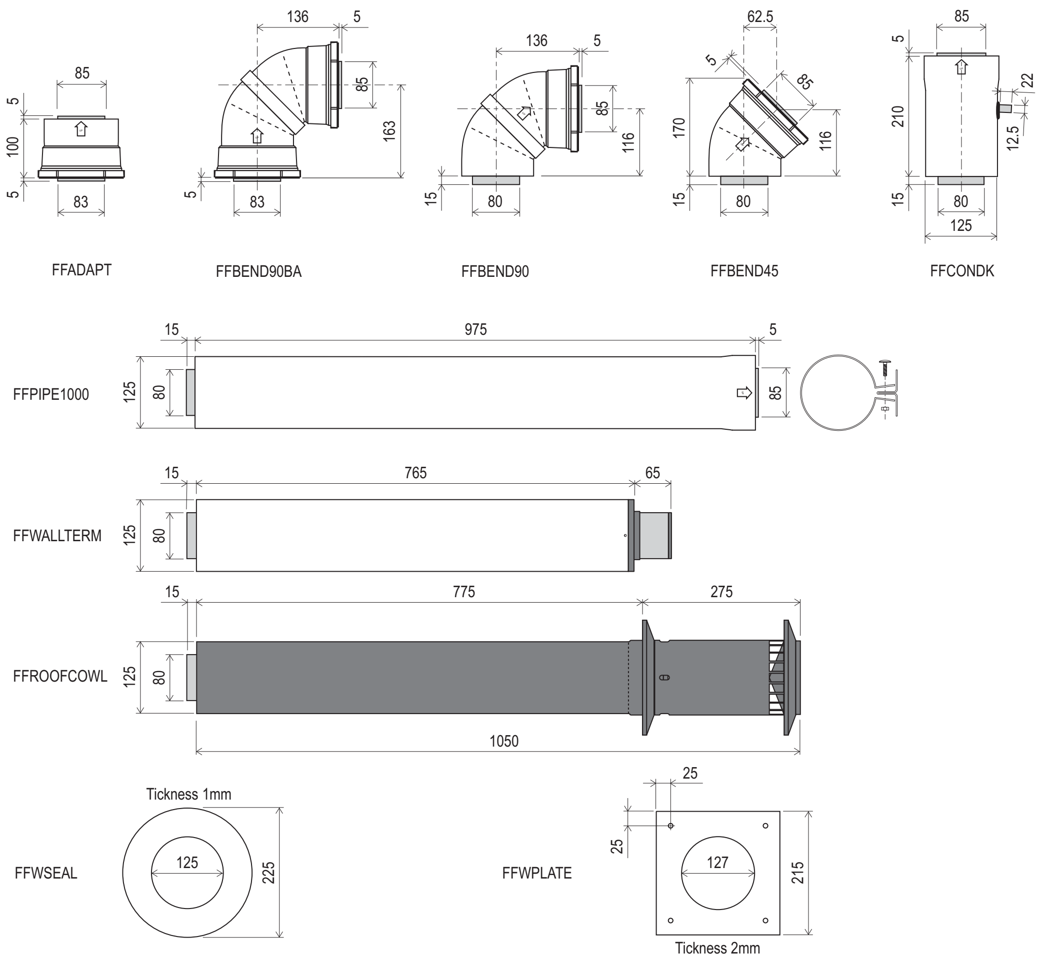


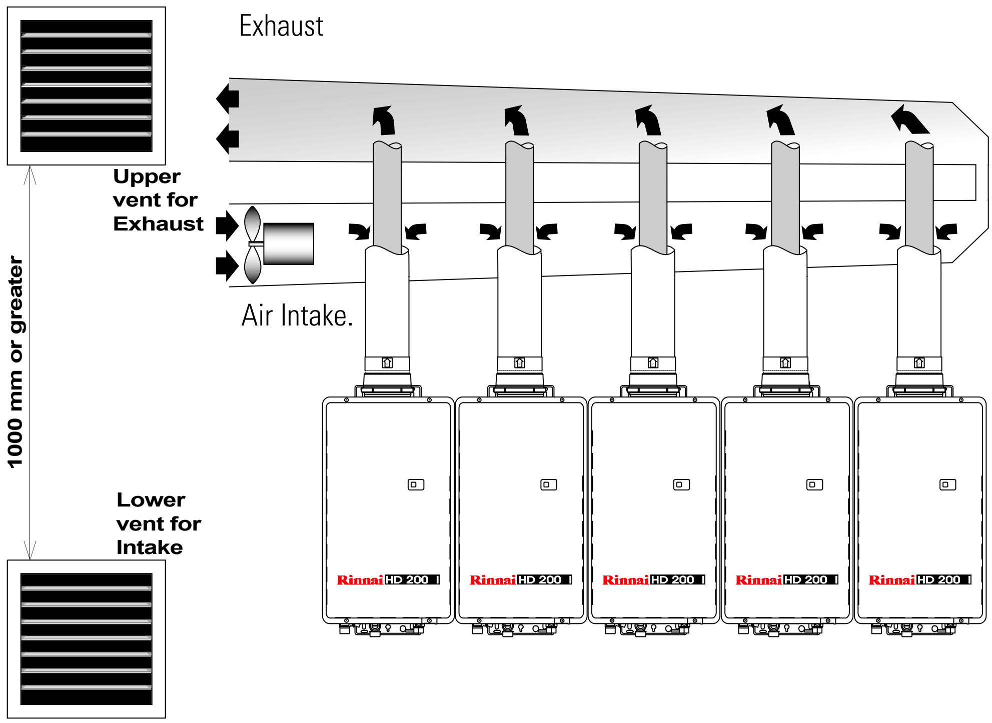
Figure 5.6: Flueing Componentry FFU Models.

Table 5.1 Flueing Componentry (FFU models)

DESCRIPTION	CODE NUMBER
Vertical Adaptor	FFADAPT
Elbow 90 Degrees Bend Adaptor	FFBEND90BA
Elbow 45 Degrees (2 in Box)	FFBEND45
Elbow 90 Degrees	FFBEND90
Condensate Trap	FFCONDK
Flue Pipe 1000mm length	FFPIPE1000
Horizontal Flue Terminal	FFWALLTERM
Vertical Flue Terminal	FFROOFCOWL
Ceiling Ring	FFWSEAL
Wall Plate	FFWPLATE

5.6 Alternative Flueing for Multiple installations (FFU range)

A room sealed powerflued system for flueing multiple Rinnai V-Series FFU water heaters has been designed by Rinnai. A patent for this system has been applied for. This system has been designed to allow the installation of multiple V-Series FFU water heaters in areas where the use of multiple single appliance flues is difficult or expensive, for example plant rooms in multi storey buildings. There is no limit on the number of V-Series FFU water heaters installed or the distance between the installation and the outside. The system can terminate either vertically or horizontally provided that the air intake and exhaust discharge are located on the same plane. The figure below shows a horizontal termination.



The relevant parts of appendix 'H' of AS5601 / AG601 - 2002 apply and this system is subject to the regulations and approval of the appropriate Authorities. Approval should be sought for each installation. Contact Rinnai for more information.

Figure 5.7: Powerflue system multiple manifolded Internal units (FFU models)

Figure 5.8 : Rinnai Power Flue system for multiple V-Series water heaters

6

CHAPTER SIX

Accessories

6.1 Security Cages - Single

The Cages are made from mild steel with a zincalume finish.

'Cage 01' is suitable for all single, externally installed Rinnai V-Series REU-V1616W, REU-V2020W, REU-V2626W, REU-V2632WC, REU-V3232W, REU-V3232WC

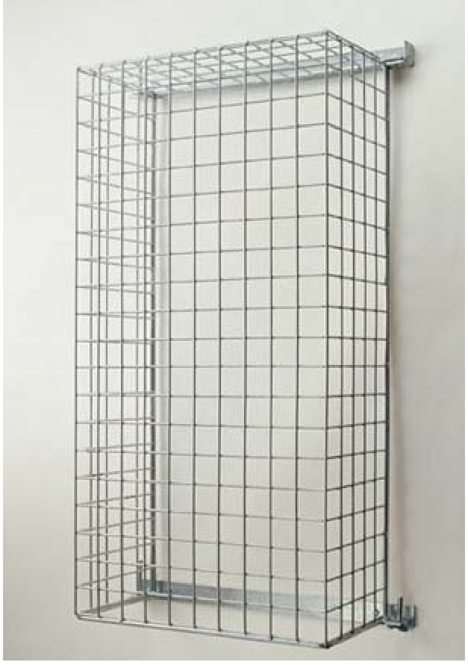


Figure 6.1: Rinnai Hot Water system Single Security Cages

6.2 Security Cages - Multiple Installations

The Modular Security Cage is suitable for V-Series Models units installed side by side. Models include: REU-V1616W, REU-V2020W, REU-V2626W, V2632WC, and REU-V3232W/ REU-V3232WC.

The Modular security cage is adaptable to cover most manifolded installations from a minimum width of 1 metre using Cages '02L' and '02R', and by adding extra modules of Cage '02C' to extend the length of the installation.

"Cage 02L" - Covers the left end, 500 mm wide
"Cage 02R" - Covers the right end, 500 mm wide.
"Cage 02C" - Extends the length of the installation in 500 mm sections

Single cages have a bottom cut out to allow easier installation of pipe work to the V-Series . Pipe work installation can be much more flexible than in previous cage design.

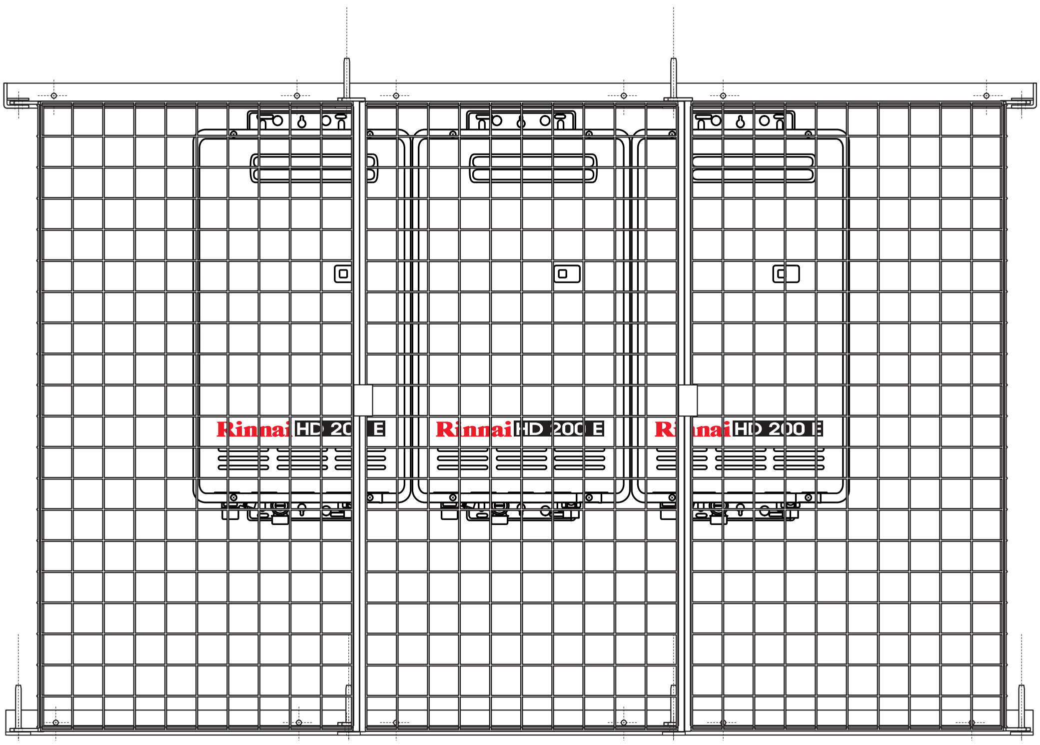


Figure 6.2: Rinnai Hot Water system Security Cages - Multiple Installations

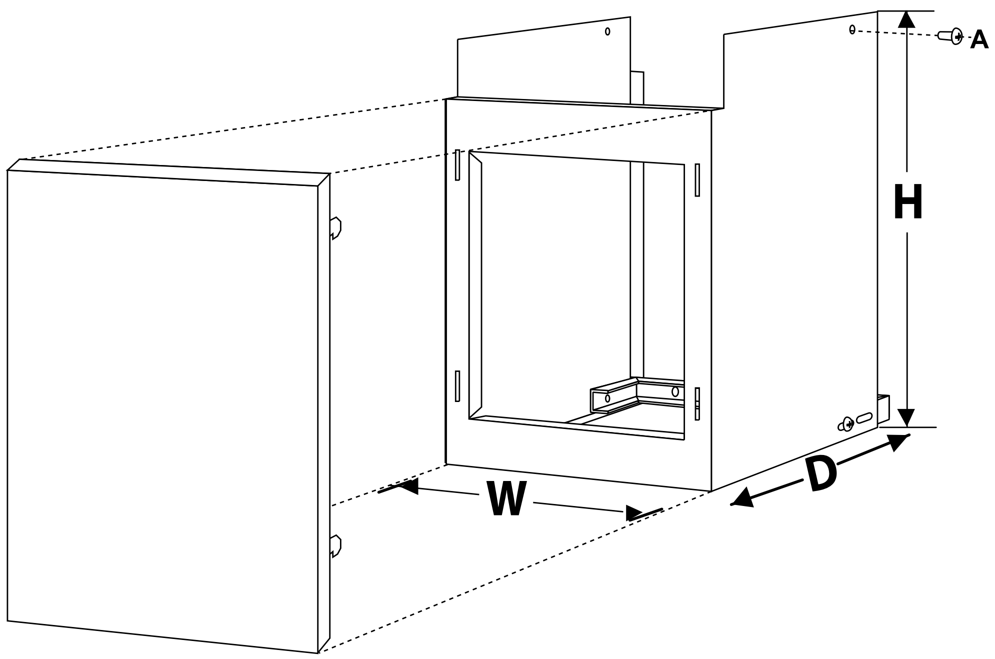
6.3 Pipe Covers

Check the correct pipe cover has been chosen for use with the following models:
PC 11: for V Series REU-V1616W and REU-V2020W,
PCV01: for V Series REU-V2626W, REU-V2632FFU, REU-V2632FFUC and REU-V2632WC.
PCV02: for V Series REU-V3232W and REU-V3232WC

Dimensions:

	PC11	PCV01	PCV02
Width: (W)	350 mm	350 mm	470 mm
Height: (H)	440 mm	440 mm	440 mm
Depth: (D)	160 mm	182 mm	210 mm

**Note: The Pipe cover is not available in the colour of the Rinnai V-Series Commercial range.*
**Check Data plate to confirm the Model Number.*



Note: Pipe covers can be joined together vertically to extend the length to cover pipes.

Figure 6.3: Pipe Covers

6.4 Recessed / Semi Recessed Box

The recessed box will reduce, even further, the space taken up by the compact Rinnai V Series range. The unit fits neatly into the box and can be painted to blend into the aesthetics of the exterior. The recess box should only be installed in brick walls.

Figure 6.4: Recess Box

RBOX04 is a fully recessed box suitable for V-Series models:
REU-V1616W / REU-V2020W.
Brick opening required: Width: 365 - 395 mm
Height: 1020 - 1050 mm, Depth: 140 mm or more.

RBOX03 is a semi recessed only.
Suitable for the REU-V2626W and REU-V2632WC models only.
Brick opening required: Width: 365 - 395 mm
Height: 1020 - 1050 mm, Depth: 140 mm or more.

RBOX02 is a fully recessed box suitable for REU-V2626W, REU-V2632WC, REU-V3232W and REU-V3232WC.
Brick opening required: Width: 495 - 530 mm
Height: 1020 - 1050 mm. Depth: 230 mm or more.

RBOX02F is an optional semi recessed frame to suit the RBOX02. RBOX02F is only compatible and must be ordered with RBOX02. Depth: 140 to 230 mm.

7

CHAPTER SEVEN

Commercial Hot Water Systems

7.1 V-Series Commercial Range

Rinnai has a dedicated range of commercial continuous flow hot water heaters. These have specially designed heat exchangers to ensure longevity in demanding applications.

The Specifications are in Section 4.4. Water Flow, Water Pressure, Water Temperature and Gas Usage data is in Section 4.9 The Water Pressure vs Flow Characteristics are in Section 4.10.

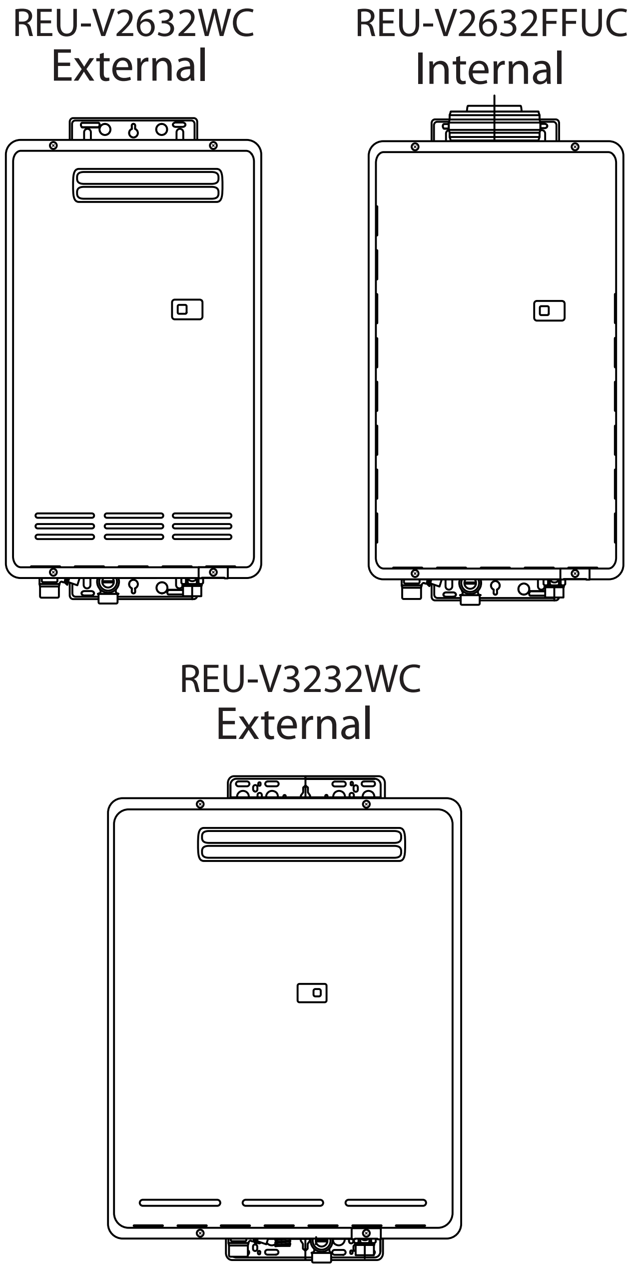
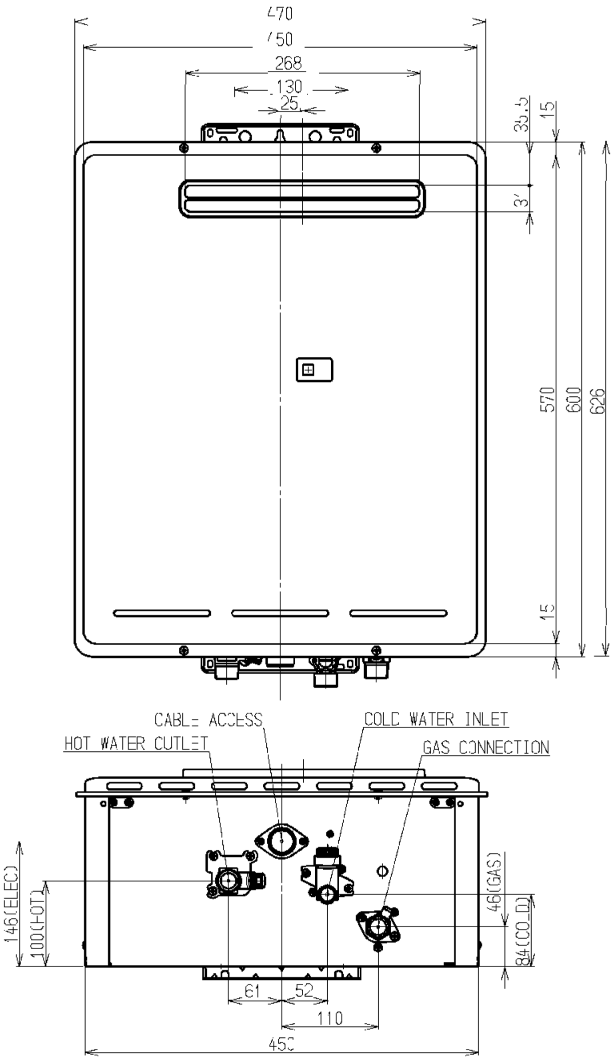
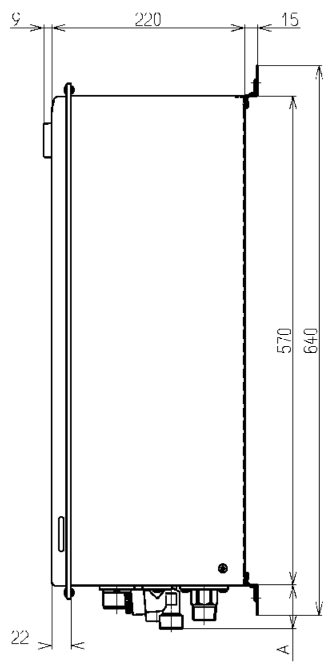


Figure 7.1: New V-Series Commercial Range

Rinnai V-Series: REU-V3232WC





	A DIMENSION
GAS	41
COLD	51
HOT	42
ELEC	27

Figure 7.2: Dimensions of Rinnai V-Series: REU-V3232WC

Rinnai V-Series: REU-V2632WC

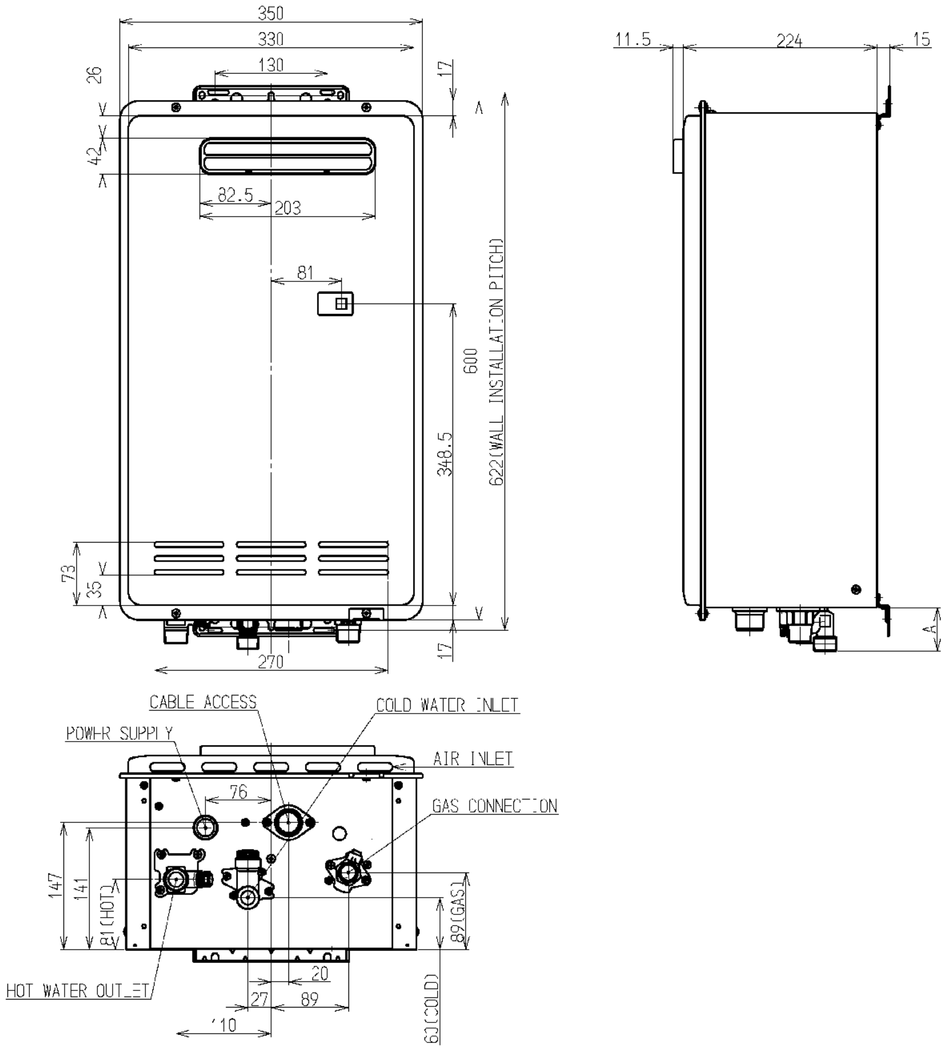
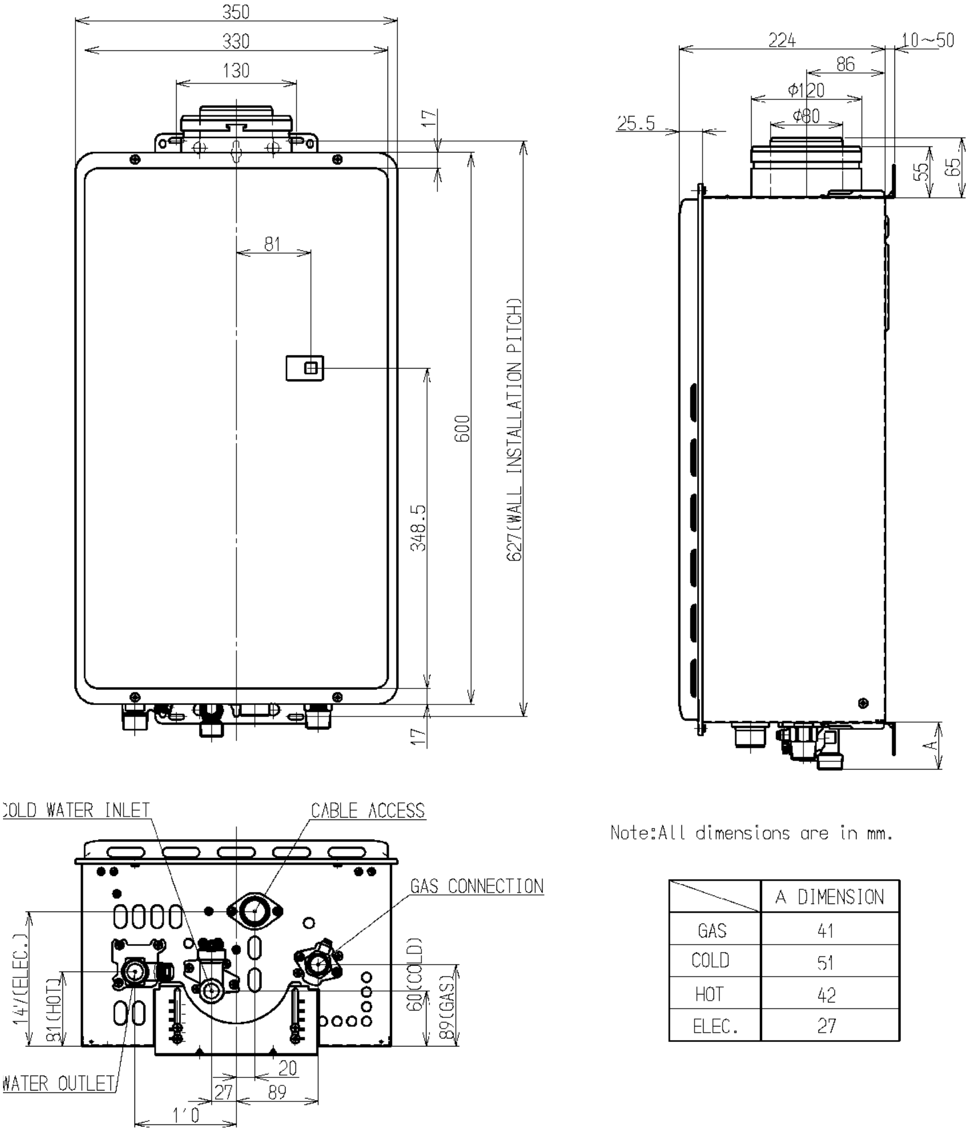


Figure 7.3: Dimensions of Rinnai V-Series: REU-V2632WC

Rinnai V-Series: REU-V2632FFUC



	A DIMENSION
GAS	41
COLD	51
HOT	42
ELEC.	27

Figure 7.4: Dimensions of Rinnai V-Series: REU-V2632FFUC

7.2 Statutory Requirements

AS/NZS 3500.4.2 - 1997 is the governing standard for installation, alteration or repair of domestic hot water systems.

Clause 1.6 of this standard requires minimum storage temperature and maximum delivery temperature for hot water systems as follows:

Clause 1.6 Water Temperature

1.6.1 **Storage temperature**. Hot water shall be stored at a minimum of 60°C to inhibit the growth of legionella bacteria.

1.6.2 **Sanitary fixtures delivery temperature**. All new hot water installations shall, at the outlet of all sanitary fixtures used primarily for personal hygiene purposes deliver hot water not exceeding:

- 45°C for early childhood centres, primary and secondary schools and nursing homes or similar facilities for young, aged, sick or disabled persons; and
- 50°C in all other buildings.

Note: Compliance with these temperature limits is optional for kitchen sinks and laundry tubs.

Note that individual States or Institutions may have their own requirements in addition to, or instead of, above.

7.3 Determining the Required Flow

When determining a hot water solution, the following issues should be considered:

- Is endless hot water required or is it required over a short period?
- Water pressure and flow requirements
- Capital cost limitations
- Running costs
- Locality of the units (external / internal)
- Flueing options
- Gas supply and availability

The following methods can be used for determining a hot water solution:

i) **Continuous Flow:**

This method is used when the demand involves all of the draw off points connected, generally at the same time, for instance a group of showers in a sports pavilion. The system may consist of:

(1) Single or multiple Commercial V-Series units with primary hot water flow pipe work only

or

(2) Single or multiple Commercial V-Series units with primary flow and secondary hot water return pipework.

Typical applications are:

- Domestic
- Restaurants
- Car washes
- Laundries
- Food processing plants
- Caravan Parks
- Correctional Facilities
- School Camps

A Continuous Flow solution provides hot water endlessly at constant temperature up to a maximum simultaneous demand or flow rate (litres per second).

The demand can be easily calculated by totalling the full flow from all the outlets used, for example, 8 showers at 12 litres/minute = 96 litres per minute at showering temperature (from Table 7.1 below).

Table 7.1: Flow Rates for Typical Outlets

Outlet Type	Outlet Flow Rate L/Min	Assumed outlet temperature °C	Hot Water Flow Rate L/min @ 65° C[1]
Bath	18	40	9
Shower	12	40	6
Handbasin	7	40	3
Kitchen sink	12	50	8.5
Washing Machine	6	50	4
Laundry Trough	14	50	8.5
Spa	18	40	9

[1] The 'hot water flow rate at 65°C' is the flow rate required to service the 'outlet flow rate' at the 'assumed outlet temperature' based on a 15°C ambient water temperature. Refer to Chapter 9 of this manual.

ii) **Average Peak Hour Demand**

This method applies when the use of draw off points occur as purely random events over the demand period. Typical applications are:

- Apartments
- Hostels
- Hospitals
- Hotels / Motels

The demand for hot water in the above applications is dependent on the following factors:

- The occupancy classification of the building
- The number and type of hot water outlets
- The number of persons accommodated
- The time of day

Due to the diversity of hot water use in these applications, the use of V-Series Commercial continuous flow hot water systems coupled with secondary storage to meet peak demand is recommended. In some applications, manifolded units connected in a flow and return system as described in (i) can also be considered.

An average demand solution provides an unlimited simultaneous demand or flow rate (litres/second) but there is a limit to the total volume of hot water (litres) that can be delivered over a time interval (say one hour).

Table 7.2: Sizing Guidelines for Commercial Applications when using Secondary Storage Tanks

Building Occupancy	**Hot Water Demand at 60° C unless Noted Otherwise**
Hotel/Motel 4 and 5 Star Accommodation 3 Star Accommodation	45 Litre/Person per peak hour 30 Litres/Person per peak hour
Hospitals, Nursing Houses, Hostels	35 Litres/Bed Over Peak Hour (mixed water at 45° C)
Restaurants • Hotel Kitchens, Cafeterias • Sandwich Shops, Snackbars	 • 5.5 Litres/Meal Over 2 Hour Peak Temperature Required at 85° C • 3 Litres/meal over 2 hour peak at 85° C
Apartment Buildings • One Bedroom (2 persons) • Two Bedrooms with Ensuites (3 Persons) • Three Bedrooms with Ensuite (4/5 persons) • Penthouse with Two Ensuites and Spa	Apartments 25 Litres/Person • 50 Litres per peak hour • 75 Litres per peak hour • 110 Litres per peak hour • 150 Litres per peak hour
Schools • Primary and Secondary • Boarding	 • 4 Litres/Student over 8 hours (mixed water at 45° C) • 30 Litres/Student per peak hour
• Office Amenities	4 Litres/Person Over 8 Hours
• Car Washes	75 Litres/Bay/Cycle
• Coin Operated Laundries • Commercial Laundries (Machines up to 50 Kg Capacity)	• 70 Litres/Machine Per Hour • 6-8 Litres/Kg of Dry Washing

Table 7.2 is based on industry experience and is provided to serve as a guide only.

7.4 System Configurations

This information and illustrations in this section are intended as a guide only and do not imply compliance with water or gas installation standards, regulations or local requirements. Refer also to Chapter 8: Guidelines for Installation.

a) **Continuous Flow Systems**

A continuous flow solution provides hot water endlessly at constant temperature up to a maximum simultaneous demand or flow rate (L/sec).

- Individual Unit Applications

A single V-Series unit with simple water inlet and outlet pipework can be used to satisfy many commercial applications. Up to 1920 litres (at a 25°C rise) of hot water can be provided per hour, satisfying the needs of many restaurants, Child Care Centres, etc. Internal or external models are available. These applications should be limited to situations with short pipe runs to avoid dead legs and wasted water. Temperature control panels are recommended for these application.

For longer pipe runs a single V-Series unit with flow and return pipework is recommended. Temperature control panels are not recommended for this application. In Flow and Return applications the pump flow rate must be greater than the minimum flow required to operate the unit. To achieve this it is recommended that the recirculating pump has a flow rate of at least 0.05 L/sec (3 L/min). Refer to Chapter 8.8 Sizing Recirculating Pumps.

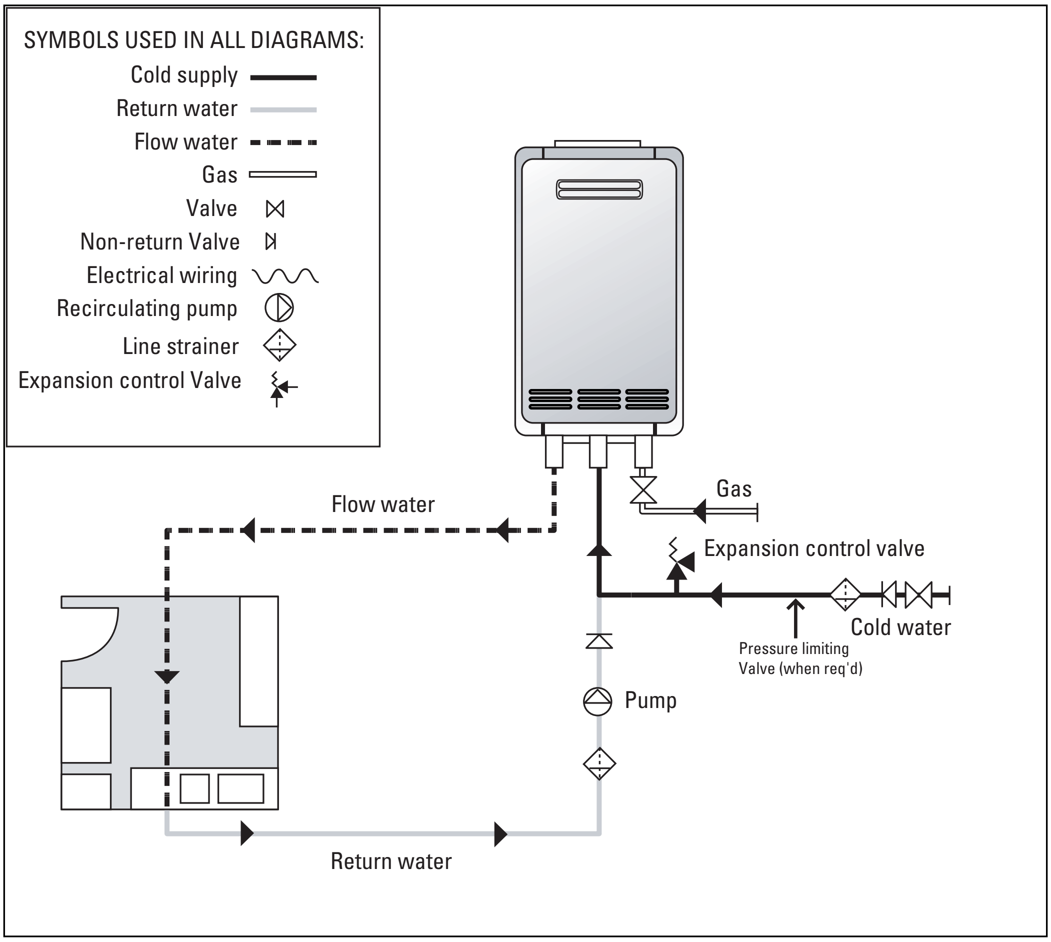


Figure 7.5: A Single V-Series Unit with Flow and Return pipework

All Rinnai water heaters are supplied with installation instructions which must be observed to ensure compliance with the warranty conditions.

Installations must be in accordance with:

- Installation instructions.
- Current version of National Plumbing and Drainage Code AS 3500.
- Current version of AG 601, AGA Installation Code for Gas Burning Equipment.
- Any other local requirements.

- **Multiple Unit Applications**

Manifolded Units without Flow and Return Pipework

Rinnai Commercial water heaters can be manifolded together, by connecting them in parallel, to enable a greater hot water flow rate than is possible with a single unit. This is particularly useful in applications such as sporting clubs, and caravan parks.

When two or more units are connected in parallel, the cold water supply would normally be split evenly between each unit. This means that a higher water flow rate is required to activate both units together than is required to operate one unit. For example, if two units were connected in parallel, a minimum flow rate of 4.8 L/min (2.4 L/min to each unit) would be required to activate both units. This problem is easily overcome by staging the operation of the V-Series hot water units by using either the MECS or PAM Valve system. This will allow the unit to ignite in sequence and ensure that hot water is available at flow rates from 2.4 L/min. upwards. PAM Valves are only available with Rinnai manifold packs as described in Section 11.

Applications without flow and return pipework should be limited to situations with short pipe runs to avoid dead legs and wasted water.
Temperature control panels are not recommended for this application.

The diagram below shows a possible layout for 5 units connected in parallel.

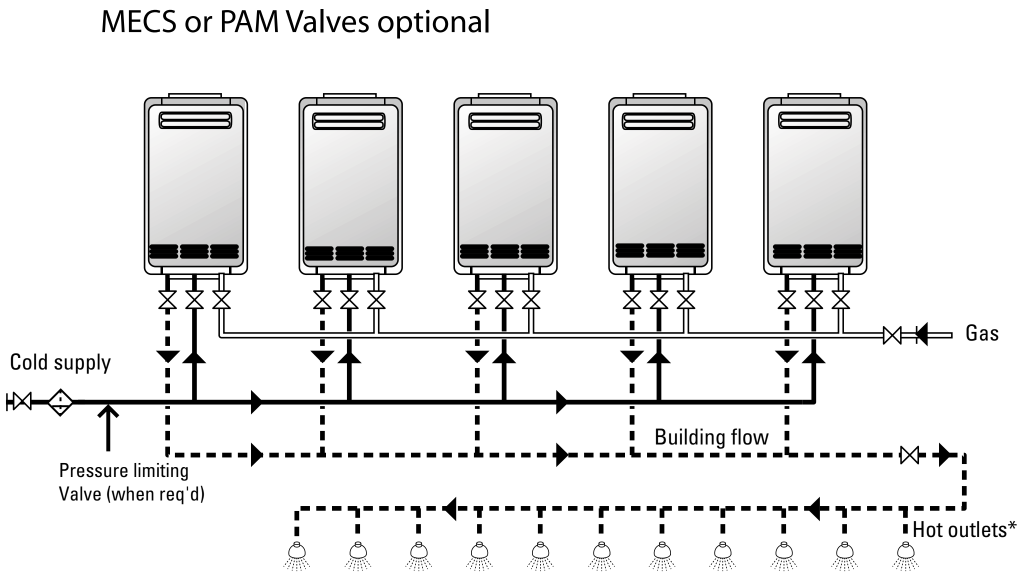


Figure 7.6: Five V-Series water units connected in parallel

Table 7.3: Flow Rates of Manifolded REU-V2632WC water heaters

No of Units	Max Flow L/min.	Max Flow L/hr	Outlets at one time	
			6.5 L/m	13 L/m
1	26	1560	4	2
2	52	3120	8	4
3	78	4680	12	6
4	104	6240	16	8
5	130	7800	20	10

Assumptions:

Maximum flow rates quoted assume an outlet temperature of 40°C and an ambient temperature of 15°C. Flow rates are measured at the unit.

Manifolded units with Flow and Return Pipework

For longer pipe runs flow & return pipework is recommended to overcome heat losses in longer pipe runs. Temperature control panels are not recommended in flow and return applications.

When MECS or PAM valves **are not** incorporated the secondary recirculating pump is required to have a minimum flow rate of 3 L/min for each V-Series hot water unit. This is to ensure that when there is no demand for hot water, **all units** are able to operate which enables the flow and return loop temperature to be maintained.

When MECS or PAM valves are incorporated the secondary recirculating pump is required to have a flow rate of at least 3 L/min. This is to ensure that when there is no demand for hot water, one unit is able to operate which enables the flow & return loop temperature to be maintained.

MECS or PAM Valves optional

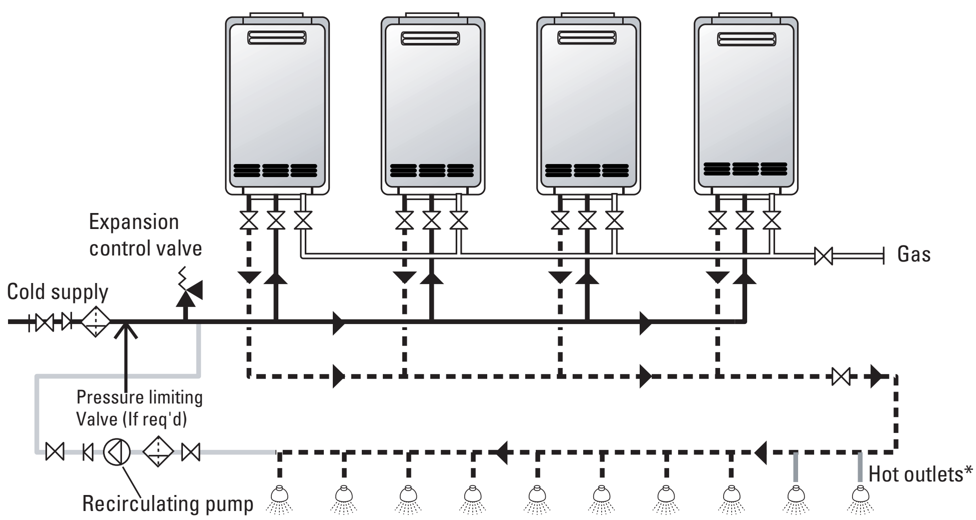


Figure 7.7: Manifolded Units with Flow and Return Pipework

* The number of outlets is pictorial only and may vary.

• Manifold Electronic Control System (MECS)

The MECS system electronically activates the number of water heaters in relation to the required hot water flow. It also ensures the work load of the water heaters is shared by changing the operational sequence, for up to a maximum of 5 water heaters manifolded together.

When MECS is used in a flow and return applications, it is recommended that an electric timer be fitted to the flow and return pump to periodically interrupt the pump operation and thus the return water flow. This will assist the MECS system to evenly load the water heaters.
The MECS system can be factory fitted or installed on site by an authorised person following the comprehensive instructions supplied. This system requires no adjustments or regular maintenance and will assist trouble free operation and promote longer life for each water heater. The V-Series hot water heaters can be ordered from Rinnai with MECS already fitted. Alternatively MECS can be installed by an authorised person. MECS uses a Master Communications PCB in the first V-Series water heater which controls the operation of the first and subsequent water heaters via communication cables connected to the V-Series water heater PCB's.

Table 7.4: MECS Parts List Packs for Rinnai V-Series Hot Water systems

Model Number	Component Number
REU-V2632FFUC	REU-MSA-2M for water heaters 1 and 2,
REU-V2632WC	REU-MSA-2S for water heaters 3, 4 and 5
REU-V3232WC	REU-MSA-M Pack A for water heaters 1 and 2, REU-MSA-S Pack B for water heaters 3, 4 and 5.

The MECS system is **not** compatible with models: REU-V1616W and REU-V2020W
MECS can be factory fitted or be installed by an Authorised person.

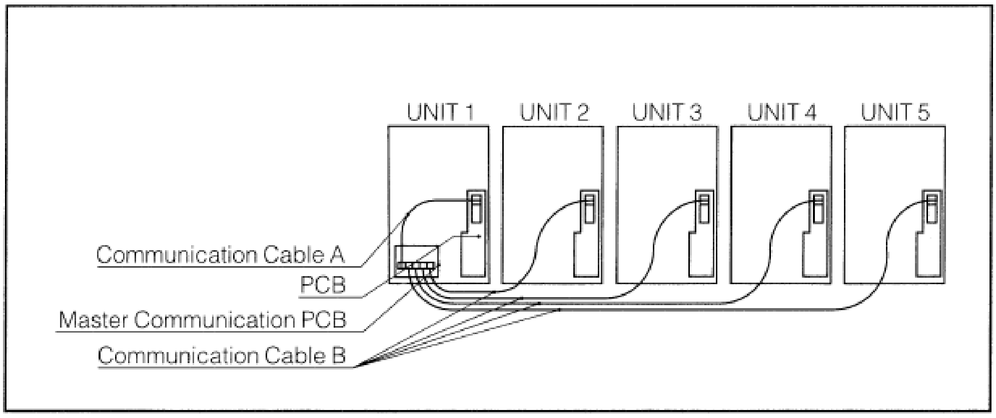


Figure7.8: MECS components

- **Pressure Activated Manifold Valve (PAM Valve)**

The PAM Valves open and shut in response to hot water flow demand. The valves can be manually adjusted to open sequentially in response to increasing hot water flow demand. As each PAM Valve opens water will flow through the V-Series hot water unit connect to it and allow it to activate. The design and construction of these valves ensures that they cannot open at flows less than required to activate the V-Series hot water units. This prevents cold water from passing through the system.

Note: PAM Valves are only available on Rinnai pre assembled Commercial Manifold Packs as described in Section 11.

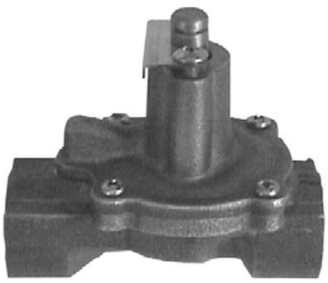


Figure 7.9: Pressure Activated Manifold Valve

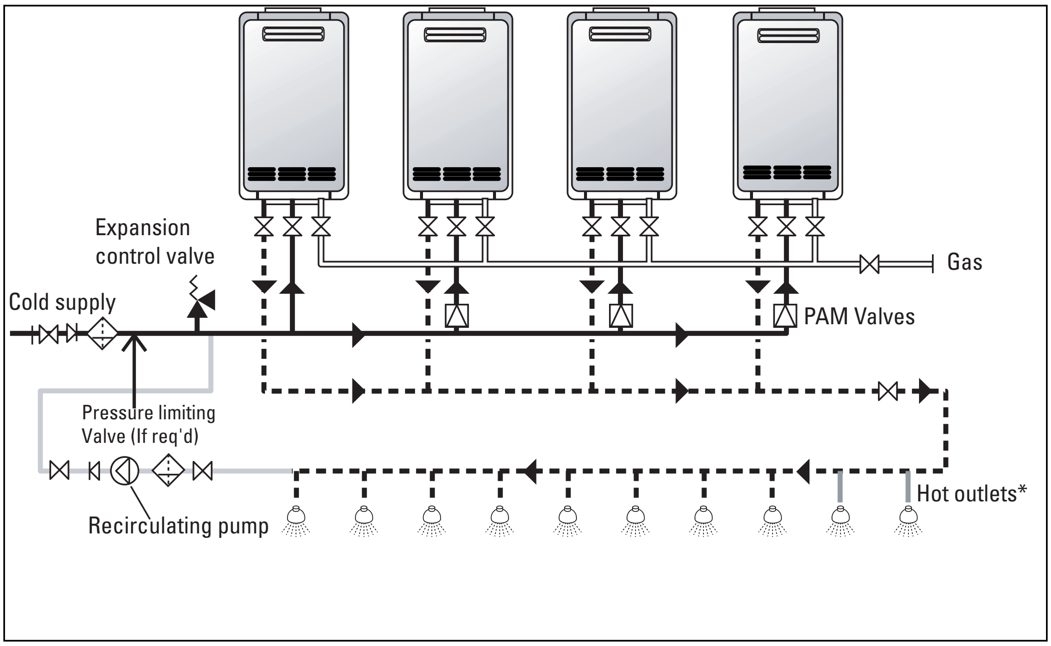


Figure 7.10: Manifolded Units with Flow and Return Pipework and PAM Valves

b) Storage Systems

Storage systems are typically used when the 'average peak hour demand' method for calculating hot water requirements is used.

V-Series hot water unit(s) with Storage tank

Rinnai V-Series water heaters can be used to maintain the temperature in a hot water storage cylinder. This type of system is suitable in cases where the hot water flow rate requirement exceeds the flow capacity of a single water heater for a limited period, or where there is an intermittently large demand for hot water, for example, hotels, hospitals and apartment buildings.

The tank temperature should be controlled by a thermostat in the storage cylinder. When the temperature in the storage tank drops below a predetermined set point, the thermostat will activate the primary circulating pump. The resulting water flow through the water heater will ignite the burner as required. Consideration should be given to incorporating a back up thermostat in case of main thermostat failure. The V-Series hot water heater must be set at a higher temperature than that of the tank thermostat to optimize system performance.

Any number of V-Series water heaters can be used in conjunction with a storage tank. Staged operation of the V-Series water heaters using MECS is not required. The primary circulating pump must be sized to provide adequate flow through each V-Series water heater.
The sizing of pumps is explained in Section 8.8.

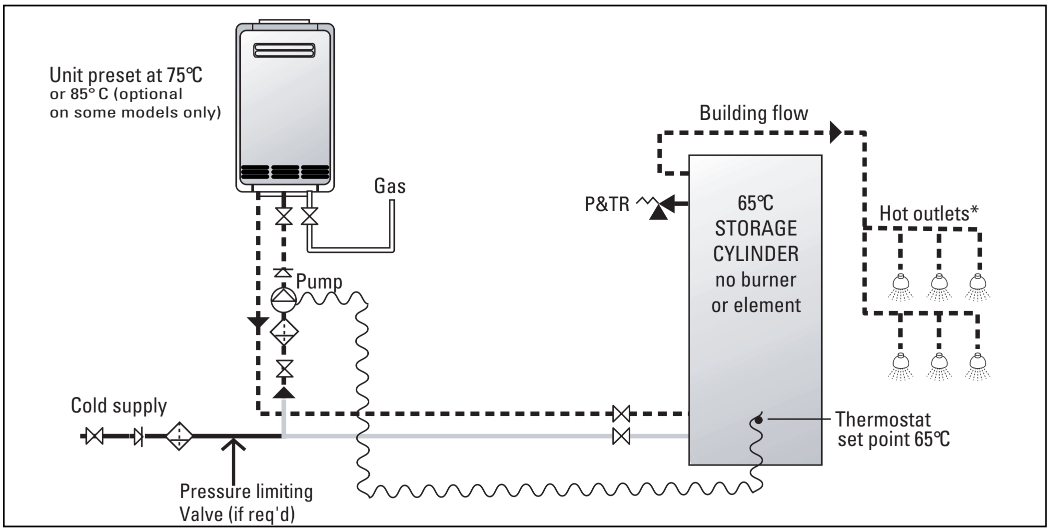


Figure 7.11: Single V-Series water heater with Storage tank

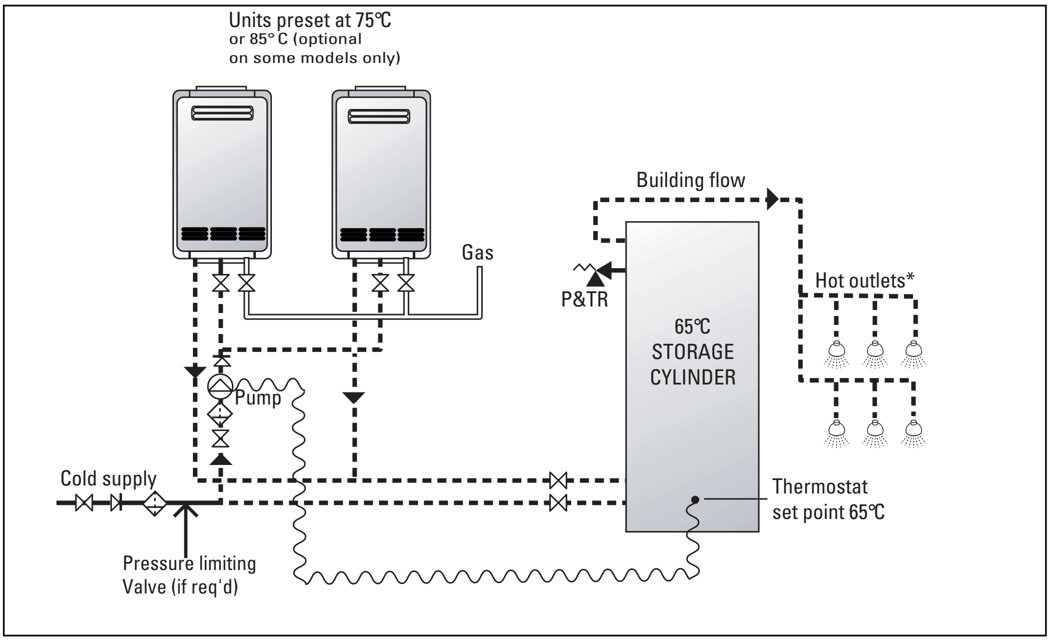


Figure 7.12: Manifolded V-Series water heaters with Storage tank

A building flow and return loop can be incorporated in tank based systems as shown in Figure 7.11. The flow and return pump must be sized to ensure loop temperature is maintained (see Section 8.8).

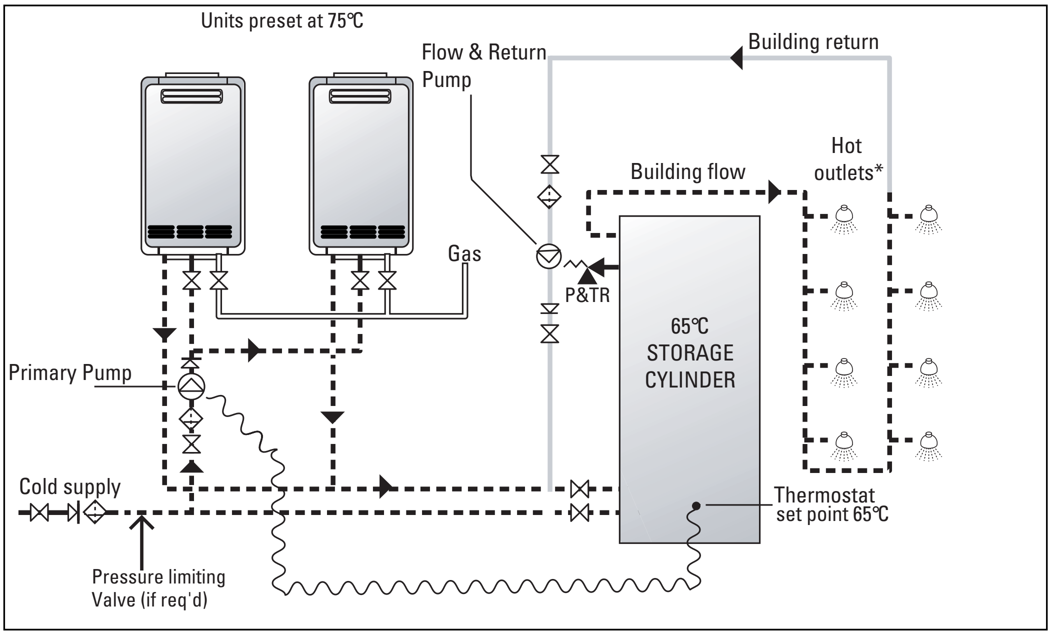


Figure 7.13: Manifolded V-Series water heaters with tank and building flow & return pipework

* The number of outlets is pictorial only and may vary.

Table 7.5 Storage System Output Guide.

No. of V Series units	Maximum Gas Consumption of System	Storage tank capacity	Storage tank available capacity	Output 1st hour (litres)	Output 2nd hour (litres)	Approximate Heat up time from cold (minutes)
1	199	315	284	1076	792	31
2	398	315	284	1868	1584	16
3	597	315	284	2660	2376	10
4	796	315	284	3452	3168	8
5	995	315	284	4244	3960	6
1	199	600	540	1332	792	59
2	398	600	540	2124	1584	30
3	597	600	540	2916	2376	20
4	796	600	540	3708	3168	15
5	995	600	540	4500	3960	12
1	199	800	720	1512	792	79
2	398	800	720	2304	1584	40
3	597	800	720	3096	2376	26
4	796	800	720	3888	3168	20
5	995	800	720	4680	3960	16
1	199	1000	900	1692	792	99
2	398	1000	900	2484	1584	50
3	597	1000	900	3276	2376	33
4	796	1000	900	4068	3168	25
5	995	1000	900	4860	3960	20

Notes:

V series unit is assumed to be model REU-V2632WC pre-set to deliver 75° C.

Ambient temperature assumed to be 15 C. Tank thermostat set point assumed to be 65° C.
This yields a temperature rise of 50° C in the system.

Primary pumps sized in accordance with Section 8.8 Table 8.8 (b).

Storage tank available capacity is assumed to be 90% of the storage tank capacity

Heat up times from cold are approximate only and may vary from installation to installation.

c) Hydronic Heating

The Rinnai V-Series Commercial models REU-V2632WC, V2632FFUC and V3232WC can be used to provide hot water for hydronic heating. These models are suitable for the supply of hot water to skirting convectors, panel radiators, fan coils, fan convectors or floor heating coils.

Note: The heat output of the water heaters depends on the characteristics of the hydronic heating system in question, in particular temperature loss characteristics and water flow characteristics. Depending on these variables, the rated output of the water heaters may not be achieved.

Hydronic heating components are available from a hydronic heating company or contact Rinnai for more information.

V-Series water heaters can also be installed in a similar configuration for heating water in polypipe recirculating systems such as those used in some greenhouses.

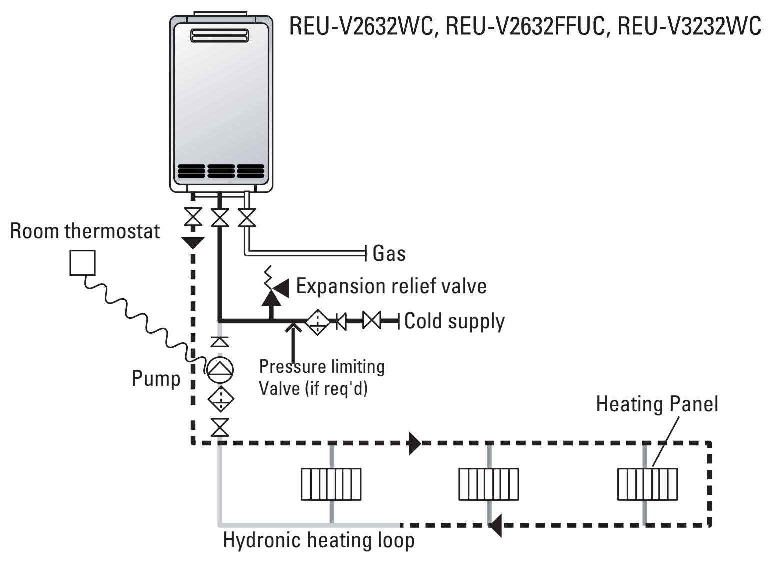


Figure 7.14: Mains pressure Hydronic Heating system

* The number of outlets is pictorial only and may vary.

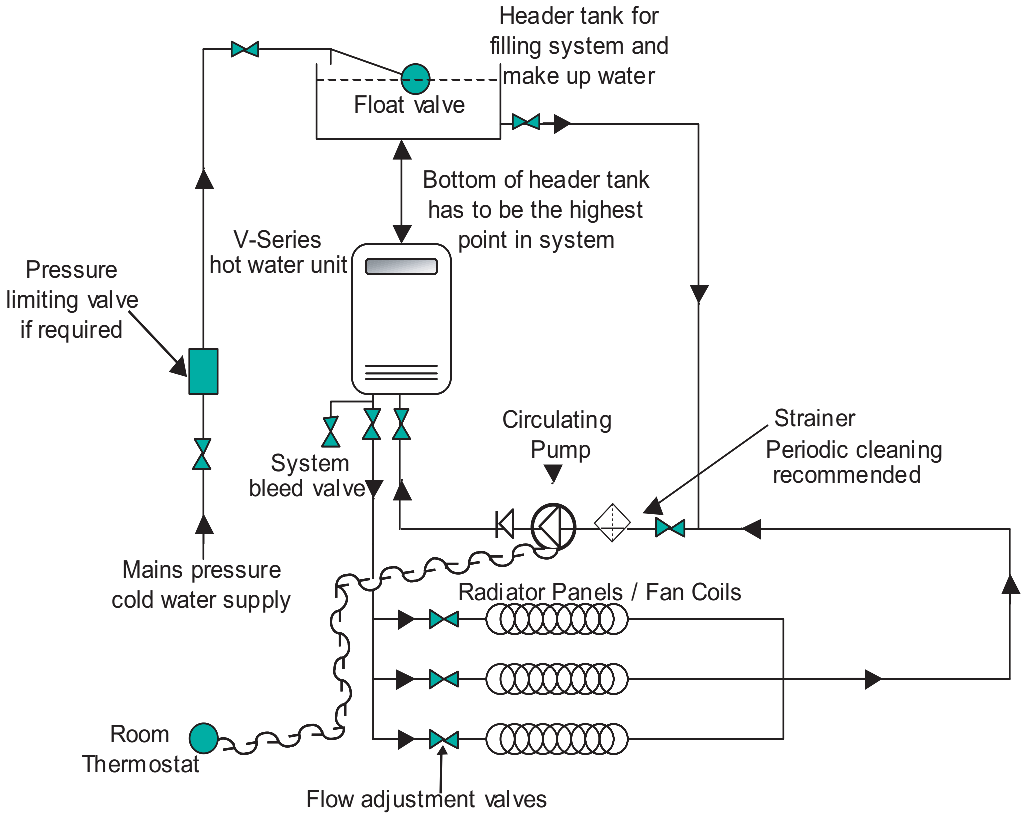


Figure 7.15: Low pressure Hydronic Heating system

d) **Heat Exchanger Applications**

V-Series hot water units can be used in heat exchanger applications as illustrated below.

Heat exchangers are generally used when the water being heated falls outside of the water quality guidelines of Section 8 2 (for example, swimming pool water) or when a fluid other than water requires heating. Heat Exchangers can also be used in water heating applications where the flow rates and/or temperature rise characteristics of the heated water fall outside of those specified for the V-Series water heater range.

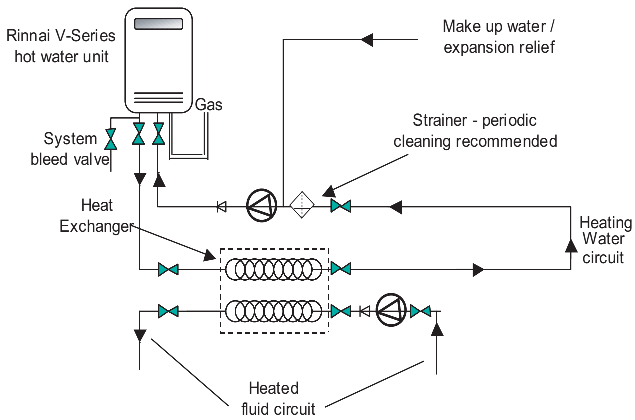


Figure 7.16: Heat Exchanger application

e) **Packaged Hot Water Systems**

Packaged hot water systems using the V-Series water heaters are now available from various suppliers including Pump and Electrical Engineering Services based in Victoria and Demand Duo based in South Australia. Examples of actual installations using these systems are shown in Chapters 10 and 11.

7.5 Configuration Examples

Example 1: Apartments

Due to the diversity of use, multiple apartment/unit installations require storage to meet peak instantaneous demand requirements.

A six storey development comprises:

- 4 one (1) bedroom units
- 5 two (2) bedroom units
- 6 three (3) bedroom units

From Table 7.2 determine the hourly demand @ 60°C:

1 bedroom units, 4 x 50 litres	=	200 (assume 2 people per 1 bedroom unit)
2 bedroom units, 5 x 75 litres	=	375 (assume 3 people per 2 bedroom unit)
3 bedroom units, 6 x 110 litres	=	660 (assume 4.4 people per 3 bedroom unit.)
		1235 litres

Assuming a 15°C ambient water temperature and a storage temperature of 65°C, a temperature rise of 50°C is required.

From Table 4.10(b) the REU-V2632WC will provide 792 L/hour at a 50°C rise.

Two REU-V2632WC's manifolded together will provide 1584 L/hour.

Two REU-V2632WC's coupled with a 315 litre storage tank will provide 1899 Litres in the 1st hour and 1584 litres in the 2nd hour. (Refer Table 7.5). A secondary flow and return system will reticulate hot water to each floor level.

For running costs refer Chapter 9.12, example 1.

Example 2: Sporting Stadium Change Rooms

A sporting facility change room has 10 showers and 6 basins. The showers have roses with a flow capacity of 12 L/min. Showering temperature is assumed to be 42°C. As the use of basins is intermittent they are not included in the calculations. The incoming water temperature is 15°C.

The maximum simultaneous demand = 10 x 12 = 120 L/min of mixed water at 42°C.
kW output required to heat 120 L/min over a 27° temperature rise:
kW output = flow (L/sec) x 4.2 x temperature rise.
kW = 2 x 4.2 x 27 = 226.8 kW

The REU-V2632WC units have an output of 47.2 kW (from Table 4.1). Hence the number of units required = 226.8 kW ÷ 47.2 = 4.8 units (or realistically 5 units)

An alternative method for calculating the number of V-Series units required is as follows:

From Chapter 9.5, the formula for calculating the quantity of mixed water is as follows:

$$\text{Mixed Water flow rate} = \frac{\text{(Hot Water flow Rate) x (Temperature Rise from cold to hot)}}{\text{(Temperature Rise from cold to mixed water)}}$$

From this formula the required hot water flow rate can be calculated:

$$\text{Hot Water flow rate} = \frac{\text{(Mixed Water flow Rate) x (Temperature Rise from cold to mixed water)}}{\text{(Temperature Rise from cold to hot water)}}$$

$$\text{Hot Water flow rate} = \frac{120 \text{ L/min x } (42 - 15)}{(50 - 15)}$$

Hot Water flow rate = 92.6 L/min = 1.542 L/sec. @ 50°C.
kW heating capacity required = 1.542 L/sec. x 4.2 x (50 - 15) = 226.8

The REU-V2632WC units have an output of 47.2 kW (from Table 4.1). Hence the number of units required = 226.8 kW ÷ 47.2 = 4.8 units (or realistically 5 units)

Five REU-V2632WC units can be manifolded together to meet this application. It is recommended that MECS is used to sequence the operation of the units to meet the flow demand.
For running costs refer Chapter 9.12, example 2.

Example 3. 4 Star Motel Unit with 45 rooms

A 45 room motel has a 100% occupancy rate with an average of 1.5 persons per room.

From Table 7.2 allow 45 litres of hot water per person per peak hour.

Hot water requirement:

45 rooms x 45 litres per person x 1.5 people per room = 3037 litres per peak hour @ 60°C
Assuming incoming water temperature is 15°C and stored water at 60°C
Heating output = M (Litres/sec) x 4.2 x Temperature rise = 0.843 x 4.2 x 45 = 159 kW.
(From Table 4.1), the output of one REU-V2632WC is 47.2 kW.
159 ÷ 47.2 = 3.4 units. Realistically 4 x REU-V2632WC units are required.
Storage backup to meet peak demand = approx. 20% of 3037 litres = 600 Litres.
Manifold 4 x REU-V2632WC hot water units with a 600 litre storage cylinder.

Alternative calculation for the number of REU-V2632WC units required.

Assume incoming water temperature of 15°C and stored water at 60°C.
Temperature rise = 60 - 15 = 45°C.
From Table 4.10 (c) the flow from 1 REU-V2632WC = 900 L/hour under these conditions.
Number of units = 3037 ÷ 900 = 3.4 units. Realistically 4 x REU-V2632WC units are required.

Heat up time of tank from Table 7.5 is approx. 15 minutes.

8

CHAPTER EIGHT

Guidelines for Installation

All Rinnai water heaters are supplied with installation instructions which must be observed during installation.

Installations must also conform with:

- Current verion of AS 3500 National Plumbing and Drainage Code.
- Current version of AG 601/AS5601, Gas Installations.
- The relevant State or Territory Plumbing and Gas Regulations.
- The relevant State or Territory Electrical Regulations.
- Applicable Building Codes
- Any other applicable local Regulations.

8.1 Water Connections

Rinnai water heaters are designed for direct connection to the mains cold water supply.

AS 3500.1.2–1998 requires that each appliance be fitted with an isolating stop valve which should be the first fitting on the cold water supply pipe to enable the water heater to be isolated for maintenance and repair. It is recommended that these valves can either be of the gate or ball valve configuration. Inlet and outlet dimensions are detailed in Sections 4.5 & 7.1.

8.2 Water Quality

The water quality must fall within the following limits for the Rinnai Warranty conditions to apply (Section 4.2 outlines full warranty conditions).

Table 8.1 Water Quality requirements

Description	pH	TDS (Totally dissolved solids)	Total Hardness	Chlorides	Magnesium	Calcium	Sodium	Iron
Maximum Recommended Levels	6.5 to 9	Up to 600 mg/litre	Up to 200 mg/litre	Up to 300 mg/litre	Up to 10 mg/litre	Up to 20 mg/litre	Up to 150 mg/litre	Up to 1 mg/litre

When storage tanks are used in conjunction with V-Series water heaters the storage tank manufacturers water quality requirements must also be adhered to. Where there is conflict between Rinnai's requirements and the storage tank manufacturers requirements the lower limits shall apply.

8.3 Expansion Control Valves

Some authorities require the installation of an expansion control valve in conjunction with storage cylinders. This applies especially in areas where the water has a high saturation index. In these areas it is possible that the temperature and pressure relief valve fitted to the storage cylinder can become blocked and this may cause distortion of the cylinder. Hence when Rinnai V-Series water heaters are used in conjunction with storage cylinders expansion control valves may be required.

The valve should be fitted on the cold water supply downstream of any non-return valve or pressure limiting valve.

Where single or multiple V-Series water heaters are used in conjunction with a flow and return system an expansion control valve must be fitted. This valve allows for expansion of the water in the flow and return system during the initial heat up period. Discharge from the valve may occur during this period and is normal.

Clause 4.12 of AS 3500.4.2–1997 specifies the requirements for the drain line from the expansion control valve.

8.4 Temperature and Pressure Relief Valves

Temperature and pressure relief valves are fitted to storage cylinders when used in conjunction with single or multiple V Series Continuous Flow water heaters.

AS4552/AG 102–2000 Clause 2.7.10 requires that if a combination temperature and pressure relief valve is fitted, it must comply with AS 1357 - 1992 (Parts 1 and 2) and must have a rating in kW not less than 0.21 x gas consumption. Hence for one REU-V2632WC unit the P&TR Valve must have a rating of 0.21 x 199 = 41.8 kW. For two units connected to one storage tank a minimum rating of 2 x 41.8 = 83.6 kW is required and so on.

However, in certain circumstances, State Regulators may grant exemption from these requirements. As with the expansion control valve, the requirements of AS 3500.4.2–1997 must be observed when installing the P&TR valve drain line.

8.5 Pressure Limiting Valves

Pressure limiting valves may be required in applications where the local water pressure exceeds the limits of the V-Series hot water heater or other components in the hot water supply system such as the storage tank or circulating pumps.

The actual pressure rating of the pressure limiting valve selected will depend on the anticipated incoming water pressure and the rated working pressure of system components.

8.6 Non Return Valves

Installations with 1 or more V-Series hot water units installed without storage tanks and which do not incorporate flow and return pipework do not require non return valves on the cold water supply unless dictated otherwise by local Authorities.

Installations incorporating tanks and/or flow and return systems should incorporate a non return valve on the cold water supply to the system.

All installations including circulating pumps should have a non return valve fitted on the outlet side of the pump.

8.7 Strainers

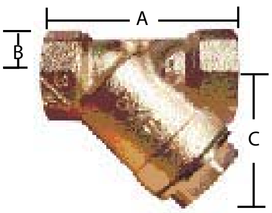
Inline strainers or filters should be used as follows:

- in all installations incorporating flow and return pipework,
- in all installations incorporating storage tanks,
- in all installations in areas of poor water quality, and
- where required by local authorities

A strainer of 18" mesh size is recommended. Periodic cleaning is recommended. Cleaning intervals will depend on the hot water system design, conditions and materials. It will also depend on local water quality.

A Rye-Y Strainer 7191-7196 Series or equivalent is recommended.

Dimensions & Weights



	15mm	20mm	25mm	32mm	40mm	50mm
A	57	66	76	90	104	124
B	10	11	13	13	14	16
C	50	61	77	92	108	132
Weight	0.2	0.3	0.5	0.7	0.9	1.5

Materials		**Technical Data**	
Body	Bronze	Inlet & outlet	Female BSP
Cap	Brass	Maximum working pressure	1600 kPa
Screen	304 Stainless Steel 18 Mesh	Maximum temperature	100° C

Figure 8.1: Rye-Y Strainer and Specifications

8.8 Sizing Recirculating Pumps

a) Primary Circulating Pumps

The performance of a storage based hot water system using Rinnai V Series water heaters can be defined in terms of two parameters:

1. The quantity of water delivered at a given temperature rise from ambient over a period of time, or Recovery Rate (litres/hour)
2. The length of time it takes for the water in the tank to be heated from ambient temperature to the thermostat set point or Heat Up Time (minutes)

These parameters are directly influenced by the flow rate through the V series unit. This flow is provided by the primary circulating pump which must hence be specified to take into account the flow rate required for the number of water heaters connected and the corresponding pressure losses through the pipework and water heater.

The sizing of primary circulating pumps and how this sizing influences system performance is best illustrated by examples.

Example 1
One REU-V2632WC is used in conjunction with a 300 litre storage tank as shown in Figure 7.11. The tank thermostat is set to 65°C. The ambient water temperature is 25 C. The water heater is pre-set to deliver water at 75° C.

Solution 1 – Sizing the primary circulating pump for maximum Recovery Rate.

Whilst the hot water system is providing hot water to the building, it is realistic to assume that all the water flowing through the primary pump comes directly from the cold supply.

The temperature rise across the REU-V2632WC unit is hence 75 – 25 = 50° C.

From Figure 4.10 (c), the maximum flow through an REU-V2632WC at a 50° C temperature rise is 13.2 l/min. At this flow rate the unit is operating at it's maximum output. Hence a primary criculating pump delivering a minimum of 13.2 l/min is required.

From Figure 4.11 (a) the pressure loss through the REU-V2632WC is approximately 30 kPa at a flow rate of 13.2 l/min. If pipe losses are ignored, a pump capable of delivering 13.2 l/min or 0.22 l/sec at a pressure of 30 kPa is required to optimise recovery rate from this system. If a pump delivering a lower flow rate is used the recovery rate from the system is reduced. If a pump delivering a higher flow rate is used the recovery rate will not increase.

Solution 2 – Sizing the primary circulating pump to minimise heat up time.

If a hot water system for a given application has been specified using the information in Table 7.2, it is realistic to assume that a tank will only be heated from ambient cold water temperature occasionally, for example, during commissioning when it is initially filled or after the system has been shut down for some time. It is also realistic to assume that there is no hot water demand from the system whilst the water in the tank is being heated.

The method for calculating heat up time is in Section 9.4. From Example 1 in Section 9.4 the heat energy required to heat 300 litres of water from 15 to 65° C is 63,000 kJ.

From Figures 4.10 and Section 9.3 Formula 2, it is seen that the heat output from a water heater is influenced by both the water flow rate and water temperature rise.

In this case, when the system is first started the inlet temperature is 15 C and the REU-V2632WC unit will deliver water at 75° C. The temperature rise (ΔT) is hence 75–15 = 60° C.

When the tank thermostat is about to turn off the pump, the inlet temperature is 65° C and the REU-V2632WC unit is still delivering water at 75° C. The temperature rise (ΔT) has reduced to 75 – 65 = 10° C.
The average temperature rise is hence (60 + 10) / 2 = 35° C.

From Figure 4.10 (c) the maximum flow rate for the REU-V2632WC at a 35° C temperature rise is 19.2 l/min or 0.32 l/sec.

From Section 9.3 Formula (2), the heat output H = 0.32 x 4.2 x 35 = 47.2 kW.
This corresponds with the maximum output specified in Table 4.1 for the REU-V2632WC.

From Section 9.4 Formula 4, the heat up time = 63000/47.2 = 1334.7 seconds = 22 minutes. Note that this is an approximate value only as it does not take into consideration heat losses from the tank and pipework and assumes the tank temperature rises linearly over time which is not the case. Actual heat up times may vary.

From Figure 4.11 (a) the pressure loss through the REU-V2632WC is approximately 80 kPa at a flow rate of 19.2 l/min. If pipe losses are ignored, a pump capable of delivering 19.2 l/min at a pressure of 80 kPa is required to optimise output from this system. If a pump delivering a lower flow rate is used the heat up time is increased. If a pump delivering a higher flow rate is used the heat up time will not be decreased.

The heat up time if the pump from solution 1 (pump 1) is used is calculated as follows:
From Section 9.3 Formula 2

$H = M \times C_{water} \times \Delta T = 0.22 \times 4.2 \times 35 = 32.34$ kW

Heat up time = 63000 / 32.34 = 1948 seconds = 32 minutes.

Comparison of Solutions 1 and 2

Solution 1 specifies a pump delivering 13.2 l/min at 30 kPa (Pump 1). Solution 2 specifies a pump delivering 19.2 l/min at 80 kPa (Pump 2). Pump 1 will most probably be significantly cheaper than pump 2 as it delivers water at a much lower pressure and can hence be of a smaller and simpler design.

Pump 2 delivers a higher flow rate than pump 1 but would not improve the recovery rate if it was chosen over pump 1. Conversely, pump 1 delivers a lower flow rate than pump 2 and would cause an increase in heat up time if it was chosen over pump 2.

Hence, the only advantage of using pump 2 over pump 1 is a decrease in heat up time from 32 to 22 minutes for this system. However, because pump 1 is probably significantly cheaper than pump 2 for most applications it would be a suitable choice as it still allows maximum recovery rate from the system when hot water is being used. The increase in heat up time is usually not a concern.

Example 2

This is the same as example 1 except that 2 x REU-V2632WC's are manifolded to circulate through the primary pipework as shown in Figure 7.10. The system is to be sized for maximum recovery rate.

Solution

Pressure losses and flows through each unit are the same as in example 1, Solution 1, that is a flow of 13.2 l/min. at a pressure of 30 kPa for each REU-V2632WC unit. A pump delivering 2 x 13.2 = 26.4 l/min. at a pressure of 30 kPa is required if pipe pressure losses are ignored. Similarly with 3 units connected in parallel, a pump capable of delivering 3 x 13.2 = 39.6 l/min. at a pressure of 30 kPa is required and so on.

Table 8.9 shows suggested primary pump models which are commercially available and primary flow and return pipework sizes for various numbers of REU-V2632WC units connected in conjunction with a storage tank. The pumps and pipework are sized to provide maximum recovery rate of the system (Approx. 13 l/min of water flow through each REU-V2632WC unit) and hence not sized to minimize heat up time of the system.

b) Secondary Recirculating Pumps

The secondary recirculating pump circulates water through the building reticulation (flow and return) systems to ensure the water stays hot, so that hot water is delivered almost instantaneously to all outlets. (Figures 7.7 & 7.11).

The duty for secondary hot water return circulating pumps is obtained by calculating the total heat emission from the pipework, including both flow and return lines.

The flow rate, F, is measured in Litres/second and is obtained from the following formula:

$$F = \frac{Q \times 10^{-3}}{4.2 \times (t_1 - t_2)}$$

where:

Q = Total heat loss from the flow and return pipework in watts.

t_1 = Temperature of primary flow of the water heater outlet.

t_2 = Temperature of secondary return entering the inlet manifold pipework.

F = Flow rate of secondary pump in Litres/second.

(The usual hot water temperature is 65°C and the maximum recommended temperature drop through the pipe system is 5°C.)

Example:

Calculate the flow of water through the hot water return pump for a six (6) storey building with a centralised hot water supply. The storage temperature is 65°C. The maximum recommended temperature drop through the pipe system is 5°C. The average ambient temperature in the building is 20°C. The flow and return pipework is lagged with 25mm wall thickness Armaflex flexible insulation and comprises the following lengths:

40mm Ø	=	23m
32mm Ø	=	6m
25mm Ø	=	9m
20mm Ø	=	35m

Table 8.3 shows heat losses for Armaflex insulation for water temperatures of 50, 60, 70 and 80 °C. The heat loss for a hot water temperature of 65°C is required. This needs to be obtained by linear interpolation as follows:

From Table 8.3, Heat Loss for a 40mm Ø pipe lined with 25mm Armaflex insulation with a hot water temperature of 60°C and an ambient temperature of 20°C is 10.2 W/m length.

Heat loss for this pipe with a hot water temperature of 70°C and an ambient temperature of 20°C is is 12.9 W/m length.

By linear interpolation, the Heat Loss for this pipe with a hot water temperature of 65° and an ambient temperature of 20°C is calculated as follows:

$$\text{Heat Loss} = 10.2 + \frac{12.9 - 10.2}{2} = 11.55 \text{ W/m length} \quad \text{or} \quad \frac{12.9 + 10.2}{2} = 11.55 \text{ W/m}$$

The total heat loss for a 23 metre length of this pipe is 213 x 11.55 = 266W.

Performing the same calculation for the other pipe diameters, the heat losses are calculated as follows:

Table 8.2: Lengths of Insulated Pipework Heat Losses: 25mm Armaflex

	Pipe Lengths (m)	**Heat Loss (W/m** length) @ 65°C	**Total Heat Emissions (Watts)**
40 mm Ø	23	11.55	266
32 mm Ø	6	10.3	62
25 mm Ø	9	9.1	82
20 mm Ø	35	8.25	289
Total Heat Losses			**699**

The total heat loss for the return pipework is 699 Watts.

The flow rate of the secondary pump will determine the temperature of the return water. If the flow rate is too low then the temperature losses of the return water will be excessive.

To determine a flow rate for the secondary pump in the above example which will limit the temperature drop in the secondary pipework to 5°C use the following formula.

Flow (L/sec) = Total Pipework Heat Losses (Kw) x 4.2 x Temperature drop (°C)

$$= \frac{699 \times 10^{-3}}{4.2 \times 5}$$

= 0.033 L/sec = 2 L/min

If a storage tank is used as shown in Figure 7.11 a pump able to deliver 2 litres per minute at a pressure equal to the head losses in the building flow and return pipework is required.

If V-Series water heaters are connected in parallel as shown in Figure 7.7 without MECS, the circulating pump will be required to displace a minimum of 3 L/min per V-Series unit connected at a pressure equal to the head loss in the water heaters and the flow and return pipework. From Figure 4.11 pressure losses through all V-Series hot water units at 3 L/min is approx. 5 kPa which is negligible.

Table 8.3: Armaflex — Heat Loss Table (Watts/metre length)

Water Temperature		50			60			70			80		
Ambient Temp.		10	20	30	10	20	30	10	20	30	10	20	30
Nom. OD	Nom. Wall												
10	Nil	12.4	9.3	6.2	15.6	12.4	9.3	18.7	15.6	12.4	21.8	18.7	15.6
	9	7.4	5.6	3.8	9.3	7.5	5.7	11.3	9.5	7.7	13.3	11.5	9.7
	13	7.0	5.3	3.6	8.8	7.1	5.4	10.7	9.0	7.3	12.6	10.9	9.2
	19	5.9	4.5	3.0	7.5	6.1	4.6	9.1	7.7	6.2	10.7	9.3	7.8
	25	5.3	4.0	2.7	6.7	5.4	4.1	8.1	6.8	5.5	9.5	8.3	7.0
12	Nil	14.9	11.2	7.5	18.7	14.9	11.2	22.4	18.7	14.9	26.1	22.4	18.7
	9	8.2	6.2	4.2	10.4	8.4	6.3	12.6	10.6	8.5	14.8	12.8	108.0
	13	7.6	5.8	3.9	9.6	7.8	5.9	11.7	9.8	7.9	14.0	12.1	10.2
	19	6.4	4.8	3.3	8.1	6.5	5.0	9.8	8.3	6.7	11.8	10.2	8.6
	25	5.6	4.3	2.9	7.1	5.8	4.4	8.6	7.3	5.9	10.4	9.0	7.6
15	Nil	18.7	14.0	9.3	23.3	18.7	14.0	28.0	23.3	18.7	32.7	28.0	23.3
	9	9.4	7.1	4.8	11.9	9.6	7.3	14.4	12.1	9.8	17.0	14.7	12.4
	13	8.5	6.4	4.3	10.7	7.2	5.4	13.0	11.0	8.9	15.3	13.3	11.2
	19	7.0	5.3	3.6	8.9	7.2	5.4	10.8	9.1	7.3	12.7	11.0	9.3
	25	6.2	4.7	3.2	7.9	6.4	4.8	9.5	8.0	6.5	11.3	9.8	8.2
20	Nil	24.9	18.7	12.4	31.1	24.9	18.7	37.3	31.1	24.9	43.5	37.3	31.1
	9	11.4	8.6	5.8	14.4	11.6	8.8	17.4	14.7	11.8	20.5	17.8	14.9
	13	10.0	7.6	5.1	12.7	10.2	7.8	15.4	12.9	10.4	18.1	15.7	13.2
	19	8.2	6.2	4.2	10.3	8.4	6.3	12.5	10.6	8.5	14.8	2.8	10.8
	25	7.1	5.4	3.6	9.0	7.3	5.5	10.9	9.2	7.5	12.9	11.2	9.4
22	Nil	27.4	20.5	13.7	34.2	27.4	20.5	41.1	34.2	27.4	47.9	41.1	34.2
	9	12.2	9.2	6.2	15.4	12.4	9.4	18.6	15.7	12.7	21.9	19.0	16.0
	13	10.6	8.0	5.4	13.3	10.8	8.2	6.2	13.6	11.0	19.0	16.5	13.9
	19	8.5	6.6	4.4	10.8	8.7	6.6	13.1	11.0	8.9	15.4	13.4	11.3
	25	7.4	5.6	3.8	9.3	7.6	5.7	11.3	9.6	7.7	13.4	11.6	9.8
25	Nil	31.1	23.3	15.6	38.9	31.1	23.3	46.7	38.9	31.1	54.4	46.7	38.9
	9	13.3	10.1	6.8	16.8	13.6	10.3	20.4	17.2	13.9	24.0	20.8	17.5
	13	11.5	8.7	5.9	14.5	11.7	8.9	17.6	14.8	12.0	20.8	18.0	15.1
	19	9.0	6.8	4.6	11.4	9.2	7.0	13.8	11.6	9.4	16.3	14.1	11.9
	25	7.9	6.0	4.0	9.9	8.0	6.1	12.1	10.2	8.2	14.2	12.3	10.4
28	Nil	34.8	26.1	17.4	43.5	34.8	26.1	52.3	43.5	34.8	61.0	52.3	43.5
	9	14.5	11.0	7.4	18.3	14.8	11.2	22.2	18.6	15.0	26.1	22.6	19.0
	13	12.2	9.2	6.2	15.4	12.4	9.4	18.7	15.7	12.7	22.0	19.0	16.0
	19	9.5	7.2	4.9	12.0	9.7	7.3	14.6	12.3	9.9	17.2	14.9	12.5
	25	8.2	6.3	4.2	10.4	8.4	6.4	12.6	10.7	8.6	14.2	12.9	10.9

Note: Calculations are for still air environment.

This table was extracted from the Armstrong World Industries (Australia) Pty Ltd Design Manual.

Table 8.3: Armaflex — Heat Loss Table (Watts/metre length) (cont.)

Water Temperature		50			60			70			80		
Ambient Temp.		10	20	30	10	20	30	10	20	30	10	20	30
Nom. OD	Nom. Wall												
32	Nil	39.6	29.7	19.8	49.5	39.6	29.7	59.3	49.5	39.6	69.2	59.3	49.5
	9	16.0	12.1	8.1	20.1	16.3	12.3	24.4	20.5	16.6	28.7	24.8	20.9
	13	13.3	10.1	6.8	16.8	13.6	10.3	20.4	17.2	13.9	24.1	20.8	17.5
	19	10.2	7.7	5.2	12.9	10.4	7.9	15.7	13.2	10.7	18.5	16.0	13.5
	25	8.9	6.7	4.5	11.2	9.1	6.9	13.6	11.5	9.3	16.1	14.0	11.8
35	Nil	43.5	32.7	21.8	54.4	43.5	32.7	65.3	54.4	43.5	76.2	65.3	54.4
	9	17.2	13.0	8.7	21.7	17.5	13.2	26.2	22.1	17.8	30.9	26.7	22.5
	13	14.2	10.7	7.2	17.9	14.5	11.0	21.7	18.3	14.8	25.6	22.1	18.6
	19	10.9	8.2	5.6	13.7	11.1	8.4	16.7	14.1	11.4	19.7	17.1	14.1
	25	9.4	7.2	4.8	11.9	9.7	7.3	14.5	12.2	9.9	17.1	14.8	12.5
40	Nil	47.3	35.5	23.6	59.1	47.3	35.5	70.9	59.1	47.3	82.7	70.9	59.1
	9	18.3	13.9	9.3	23.1	18.7	14.1	28.0	23.5	19.0	32.9	28.5	24.0
	13	15.1	11.4	7.7	19.0	15.4	11.6	23.1	19.4	15.7	27.2	23.5	19.8
	19	11.5	8.7	5.9	14.5	11.8	8.9	17.6	14.9	12.0	20.8	18.0	15.2
	25	9.9	7.5	5.1	12.6	10.2	7.7	15.3	12.9	10.5	18.0	15.6	13.1
42	Nil	52.3	39.2	26.1	65.3	52.3	39.2	74.4	65.3	52.3	91.4	78.4	65.3
	9	19.8	15.0	10.1	25.0	20.2	15.3	30.3	25.5	20.6	35.7	30.8	25.9
	13	16.0	12.1	8.2	20.2	16.4	12.4	24.5	20.7	16.7	28.9	25.0	21.1
	19	12.3	9.3	6.3	15.6	12.6	9.5	18.9	15.9	12.9	22.2	19.2	16.2
	25	10.6	8.0	5.4	13.4	10.8	8.2	16.3	13.7	11.1	19.2	16.6	14.0
48	Nil	60.1	45.1	30.0	74.7	59.7	44.8	90.1	75.1	60.1	105.2	90.1	75.1
	9	22.2	16.8	11.3	27.9	22.5	17.0	33.9	28.5	23.0	39.9	34.5	29.0
	13	17.6	13.4	9.0	22.1	17.9	13.6	27.0	22.7	18.3	31.8	27.5	23.2
	19	13.6	10.3	6.9	17.1	13.8	10.5	20.8	17.5	14.2	24.6	21.3	17.9
	25	11.6	8.8	6.0	14.6	11.9	9.0	17.9	15.0	12.2	21.1	18.3	15.4
51	Nil	63.5	47.6	31.7	79.3	63.5	47.6	95.2	79.3	63.5	111.0	95.2	79.3
	9	23.2	17.6	11.8	29.3	23.7	17.9	35.5	29.8	24.1	41.8	36.1	30.4
	13	18.4	13.9	9.4	23.2	18.8	14.2	28.1	23.7	19.1	33.2	28.7	24.2
	19	14.1	10.7	7.2	17.9	14.4	10.9	21.7	18.2	14.8	25.5	22.1	18.6
	25	12.2	9.2	6.2	15.3	12.4	9.4	18.5	15.6	12.6	21.9	18.9	16.0
54	Nil	67.2	50.4	33.6	84.0	67.2	50.4	100.8	84.0	67.2	117.6	100.8	84.0
	9	24.4	18.4	12.4	30.7	24.8	18.8	37.2	31.3	25.3	43.8	37.9	31.8
	13	19.0	14.4	9.7	24.0	19.4	14.7	29.1	24.5	19.8	34.2	29.6	24.9
	19	14.7	11.2	7.5	18.6	15.1	11.4	22.6	19.0	15.4	26.6	23.0	19.4
	25	12.6	9.6	6.5	15.9	12.9	9.7	19.3	16.2	13.1	22.7	19.7	16.6

Table 8.3: Armaflex — Heat Loss Table (Watts/metre length)

Water Temperature		50			60			70			80		
Ambient Temp.		10	20	30	10	20	30	10	20	30	10	20	30
Nom. OD	Nom. Wall												
60	Nil	75.0	56.3	37.5	93.8	75.0	56.3	112.5	93.8	75.0	131.3	112.5	93.8
	9	26.7	20.2	13.6	33.7	27.2	20.6	40.8	34.3	27.7	44.6	38.5	32.4
	13	20.6	15.6	10.5	26.1	21.1	16.0	31.6	26.6	21.5	37.2	32.2	27.1
	19	16.0	12.1	8.2	20.2	16.3	12.4	24.6	20.6	16.7	28.9	25.0	21.1
	25	13.6	10.3	6.9	17.2	13.9	10.5	20.8	17.6	14.2	24.6	21.3	17.9
67	Nil	83.4	62.5	41.7	104.2	83.4	62.5	125.0	104.2	83.4	145.9	125.0	104.2
	9	29.2	22.1	14.9	36.9	29.8	22.5	44.7	37.6	30.3	52.6	45.5	38.2
	13	22.5	17.0	11.5	28.4	22.9	17.4	34.3	28.9	23.4	40.5	35.1	29.5
	19	17.3	13.1	8.8	21.9	17.7	13.4	26.5	22.4	18.1	31.3	27.1	22.8
	25	14.7	11.1	7.5	18.5	15.0	11.4	22.5	18.9	15.3	26.5	23.0	19.4
76	Nil	94.6	70.9	47.3	118.2	94.6	70.9	141.8	118.2	94.6	165.5	141.8	118.2
	9	32.6	24.7	16.6	41.2	33.3	25.1	46.0	38.7	31.3	54.2	46.9	39.4
	13	24.9	18.9	12.7	31.5	25.4	19.3	38.2	32.1	25.9	45.0	38.9	32.8
	19	19.1	14.5	9.8	24.1	19.5	14.8	29.3	24.7	19.9	34.5	29.9	25.2
	25	15.3	11.6	7.8	19.4	15.7	11.9	23.8	19.8	16.0	29.7	24.0	20.3
80	Nil	99.5	74.7	49.8	124.4	99.5	74.7	149.3	1244.0	99.5	174.2	149.3	124.4
	9	34.1	25.8	17.4	43.0	34.7	26.3	48.1	40.5	32.7	56.7	49.0	41.2
	13	26.0	19.7	13.3	32.9	26.6	20.1	39.8	33.5	27.1	46.9	40.6	34.2
	19	19.9	15.1	10.2	25.1	20.3	15.4	30.5	25.7	20.8	35.9	31.1	26.2
	25	15.7	11.9	8.0	20.1	16.3	12.3	24.1	20.4	16.5	28.5	4.7	20.8
89	Nil	110.7	83.1	55.4	138.4	110.7	83.1	166.1	138.4	110.7	193.8	166.1	138.4
	9	37.5	28.4	19.1	47.3	38.2	28.9	52.8	44.4	35.9	*	*	*
	13	28.5	21.6	14.5	36.0	29.1	22.0	43.6	36.7	29.6	51.4	44.5	37.4
	19	21.7	16.4	11.1	27.4	22.1	16.8	33.2	28.0	22.6	39.1	33.9	28.6
	25	17.1	12.9	8.7	21.6	17.4	13.2	26.2	22.1	17.8	30.9	26.8	27.5
101	Nil	126.4	94.8	63.2	158.0	126.4	94.8	189.6	158.0	126.4	221.2	189.6	158.0
	9	42.2	31.9	21.5	53.2	43.0	32.5	59.4	49.9	40.3	*	*	*
	13	31.9	24.2	16.3	40.3	32.6	24.7	48.8	41.1	33.2	57.5	49.8	41.9
	19	24.1	18.3	12.3	30.5	24.7	18.7	37.0	31.2	25.2	43.6	37.8	31.8
	25	18.7	14.2	9.6	23.6	19.1	14.5	28.7	24.2	19.5	33.8	29.3	24.7
114	Nil	141.8	106.4	70.9	177.3	141.8	106.4	212.8	177.3	141.8	248.2	218.8	177.3
	9	46.8	35.5	23.9	59.1	47.7	36.1	65.7	55.4	44.7	*	*	*
	13	32.5	24.6	16.6	41.1	33.2	25.1	49.8	41.9	33.9	58.7	50.8	42.7
	19	26.5	20.1	13.6	33.6	27.1	20.6	40.7	34.3	40.7	48.0	41.6	35.0
	25	20.3	15.4	10.4	25.4	20.6	15.6	31.4	26.5	21.4	36.4	31.5	26.6

There are numerous other options for insulating pipe work. Thermotec, for example, has similar characteristics to Armaflex. In addition, there are fibreglass insulations with aluminium outer foils available.

8.9 Water Pipe Configuration and Sizing

a) Multiple Unit Application - Piping Configuration

When multiple Rinnai V-Series units are used Rinnai recommend that the cold water service to the inlet header shall enter the bank from the opposite end to that from which the hot water service leaves the outlet header. This also applies when storage tanks are used in the system. This ensures the flow through each V-Series unit is equal and that the system is balanced (refer Figures 8.2). Where a flow and return system is used in conjunction with a storage tank, the secondary return line is connected to the hot water header just prior to where it enters the tank. This prevents the secondary return water from directly entering the Rinnai V Series bank which may cause erratic combustion and temperature fluctuations (Refer Fig. 8.2).

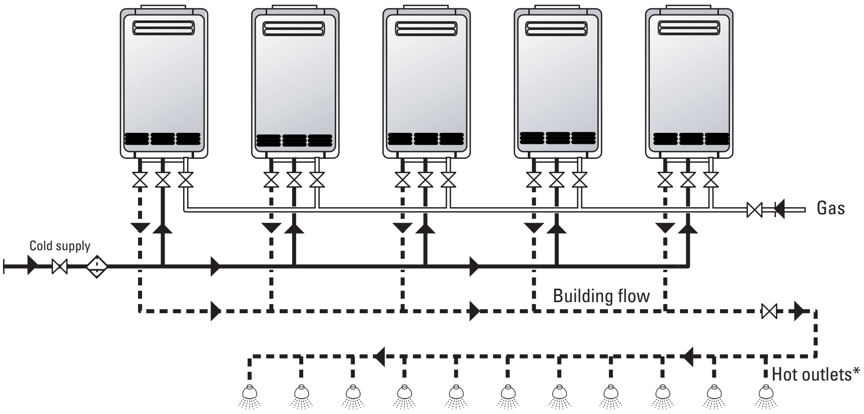


Figure 8.2 Inlet and Outlet Pipework to achieve a Balanced Continuous Flow System

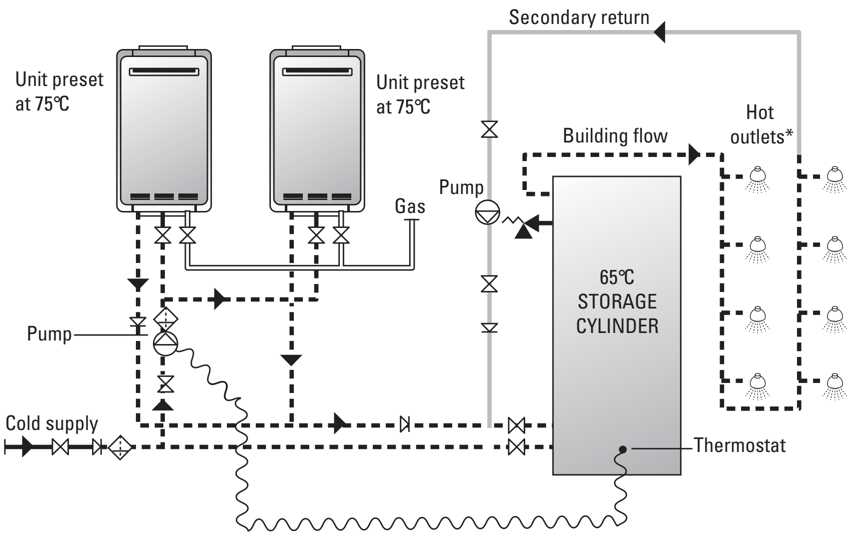


Figure 8.3 Inlet and Outlet Pipework to achieve a Balanced Storage Back up System

b) Flow Requirements

Table 3.1 of AS 3500.1.2–1998 specifies the minimum flow rates for taps, valves and cisterns.

The flow of water at a tap is dependent on the following factors:

- The towns mains pressure.
- Pressure losses due to friction through the system.
- Difference in height between the water main and the tap.
- The velocity of the water in the pipe.

c) Pressure Losses

Piping must be sized to provide the required flow at an acceptable pressure and velocity.

The water pressures that are required at taps and sanitary fixtures to give satisfactory performance to the user are shown in Table 8.4:

Table 8.4: Pressure at Taps

** The flow pressure in kPa at the entrance to the tap concerned.*
This table was extracted from the Kembla Copper Tubes Design Manual.

Taps or Sanitary Fixtures	Cold & Hot Water Flow Pressure (kPa)*
Basin	55
Spring loaded basin taps	85
Sink	35
Bath	35
Shower	85
Domestic dish washing machine	105 minimum
Domestic clothes washing machine	70 minimum
Water closet cistern	105
Urinal cistern	55
Garden hose taps	300
Urinal and water closet flushometers	30 minimum
High pressure hose down points for mortuaries, autopsy rooms, animal compounds and cages	520 to 700

The greater the velocity the greater the pressure loss due to friction.

Clause 3.4 of AS 3500.1.2 - 1998 specifies a maximum velocity in pipelines of 3 metres/second.

d) Water Pipe Sizing

If pipework is undersized for the required flow, the velocity will increase with a resultant increase in pressure loss. Pipe sizes should be selected so that the velocity is within recommended values and to minimise pressure loss.

Pressure loss charts are available from pipe manufacturers. An allowance of 20–30% in total pipe length should be made for losses through fittings and valves.

The following charts show head loss and flow information for both copper tube and cross-linked polythene piping.

If pipework is oversized for the required flow, the heat loss will increase.

Table 8.5: Capacity – Flow Rate – Head Loss Data for Water Flowing in AS 1432 Type B Copper Tubes

This table was extracted from the Kembla Copper Tubes Design Manual.

Nominal Size	Capacity	Based on 3 m/s Velocity		
		Flow Rate	Pressure Loss	
	(L/m)	(L/s)	kPa/m at 15°C	kPa/m at 60°C
DN10	0.047	0.141	14.8	12.7
DN15	0.093	0.279	9.7	8.4
DN18	0.150	0.450	7.3	6.3
DN20	0.227	0.681	5.7	4.9
DN25	0.414	1.242	4.1	3.5
DN32	0.675	2.025	3.0	2.6
DN40	0.999	2.997	2.4	2.1
DN50	1.837	5.511	1.7	1.5
DN65	2.928	8.784	1.3	1.1
DN80	4.178	12.534	1.0	0.9
DN90	5.760	17.280	0.87	0.75
DN100	7.595	22.785	0.74	0.64
DN125	12.025	36.075	0.56	0.49
DN150	17.282	51.846	0.47	0.41
DN200	31.145	93.435	0.33	0.28

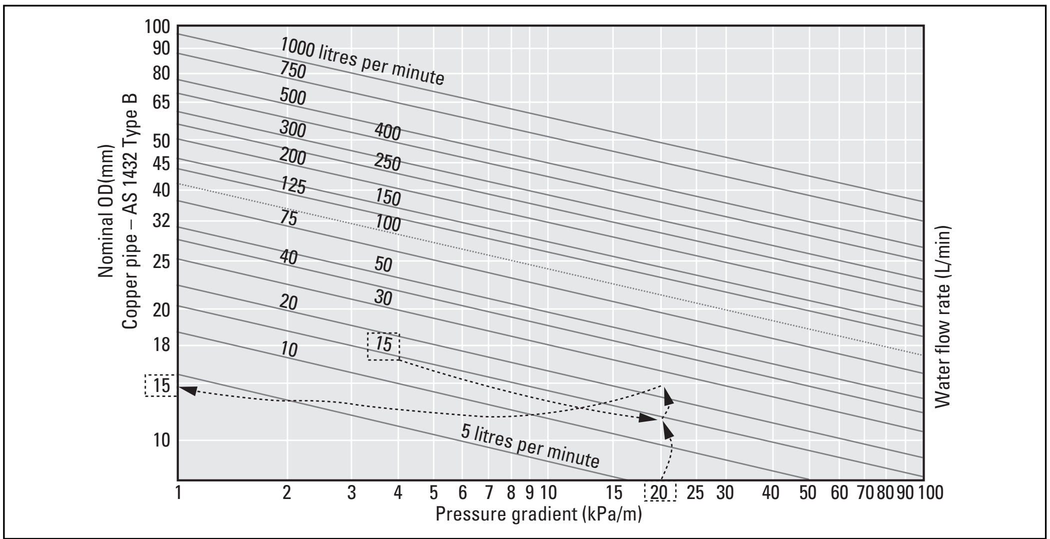


Figure 8.4: Pressure Loss and Flow Rates for Copper Pipes

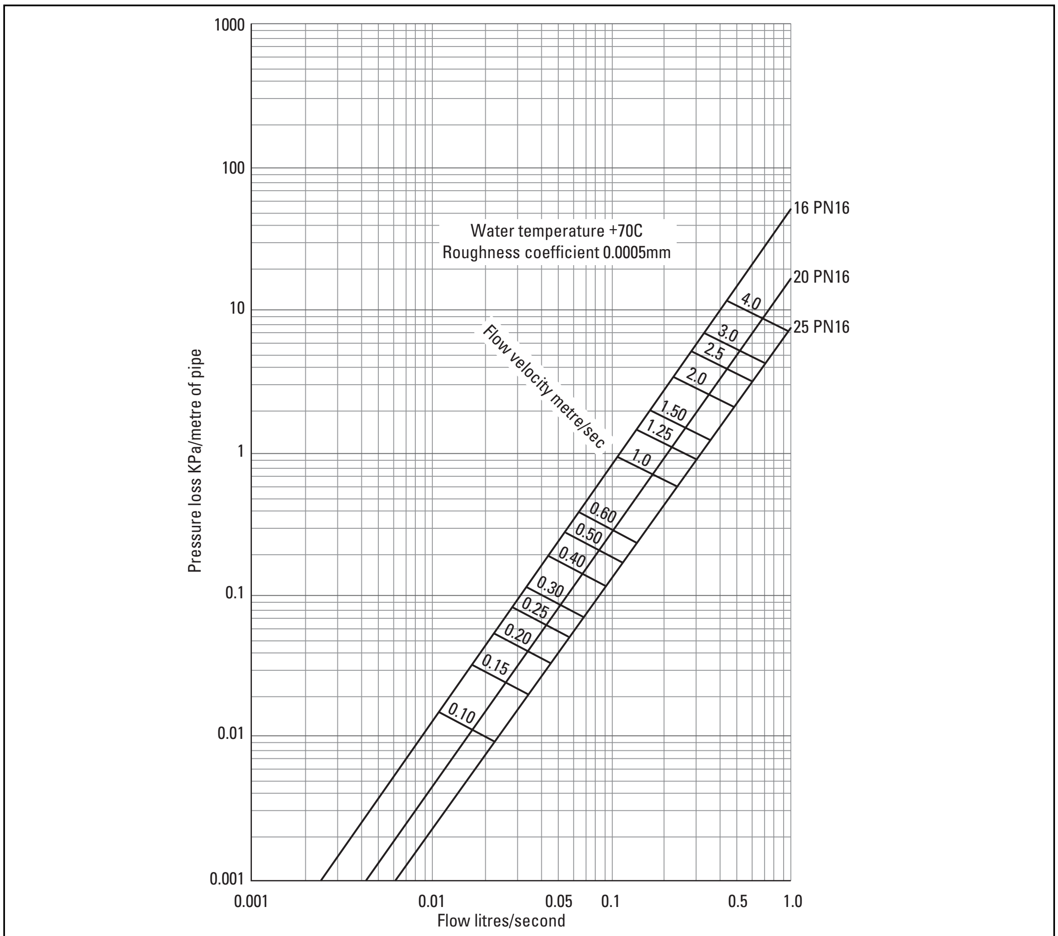


Figure 8.5: Cross-Linked Polyethylene Pipe Flow

This chart was extracted from the Auspex Australia Pty Ltd Design Manual.Auspex pipes are made to AS 2492-1994.

Example

Q. How much head loss (pressure drop) occurs in an 16 mm cross linked polyethylene (PE-X) pipe carrying hot water at 70°C with a required flow rate of 0.1 L/sec?

A. In Figure 8.3, place a ruler on the 0.1 L/sec mark on the bottom of the chart and measure up to cross the sloping line for the 16 mm pipe. From this point draw a horizontal line to the line left hand side of the chart. This gives a head loss of 0.8 kPa/metre of pipe length. Multiply this value by the length of the total pipe to give the total head loss in the pipeline in kPa. The velocity of flow in the pipe is approximately 0.9 metres/sec.

Temperature Corrections

The flow charts are calculated for water at 70°C temperature. Where the water is at a different temperature the values from the chart need to be adjusted. Multiply the head loss figure by the appropriate factor in the table.

Table 8.6: Pressure Loss and Flow Rates — Copper Pipe

Water °C	20	30	40	50	60	80	90
Factor	1.20	1.14	1.10	1.05	1.02	0.98	0.95

Table 8.7: Cross-linked Polyethylene Pipe Sizes

Full hydraulic calculations may be required for accurate sizing of pipework.

Size	Min. Mean OD	Min. Wall	Max. Mean ID
16	16.0	2.0	12.3
20	20.0	2.3	15.7
25	25.0	2.8	19.7

The following publications include detailed information for sizing of water service pipework:

- AS 3500 1.2 - 1998 — National Plumbing and Drainage: Water Supply Acceptable Solutions: available from Standards Australia.
- Selection and Sizing of Copper Tubes for Water Piping Systems: By Barrie Smith available from the Institute of Plumbing Australia.

Table 8.8: Water Pipe Sizing Table for Continuous Flow systems

As a guide, the following copper pipe sizes are recommended when using REU-V2632WC units

	Pipe Size (mm)			
No. of REU-V2632WC Units Manifolded	Max. Flow of 13 L/min per unit (1)		Max. Flow of 26 L/min per unit (1)	
	Headers A & B (Fig. 8.6)	Individual Discharge Pipes C (Fig. 8.6)	Headers A & B (Fig. 8.6)	Individual Discharge Pipes C (Fig. 8.6)
1	15 mm	15 mm	18 mm (2)	18 mm (2)
2	18 mm (2)	15 mm	25 mm	18 mm (2)
3	20 mm	15 mm	32 mm	18 mm (2)
4	25 mm	15 mm	32 mm	18 mm (2)
5	25 mm	15 mm	32 mm	18 mm (2)

Notes:

(1) Maximum flow rate is dependent on the temperature rise of water through the unit. Refer to Table 4.10.

(2) 18 mm copper tube can be substituted by 20 mm copper tube in areas where 18 mm tube may not be Commercially available.

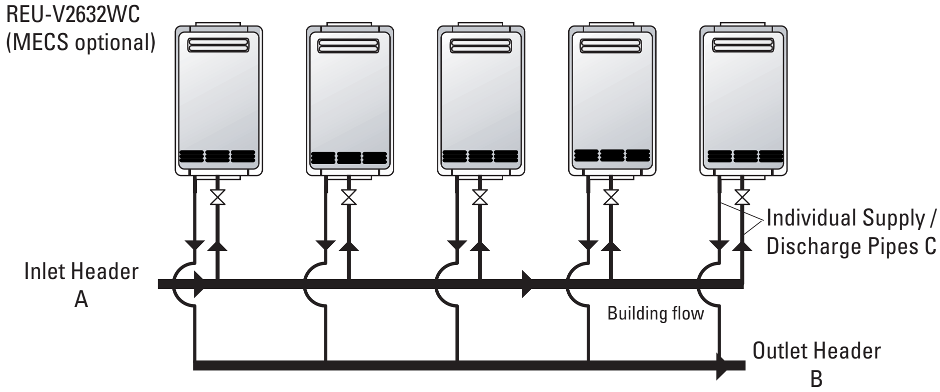


Figure 8.6: Water Pipe Sizing Schematic using REU-V2632WC units in a continuous flow system.

Table: 8.9 Pipe and Pump sizing guide for Storage Systems

No. of REU-V2632WC Units Manifolded	Pipe Size		Grundfos Pump Model (1)
	Headers A & B (Fig. 8.7) (2)	Individual Discharge Pipes C (Fig. 8.7) (3)	
1	20 mm	15 mm	UPS 20-60B, UPS 25-60B
2	20 mm	20 mm	UPS 32-80B
3	25 mm	20 mm	UPS 32-80B
4	25 mm	20 mm	UPS 32-80B
5	32 mm	20 mm	UPS 32-80B

Notes:

1. Commercially available Grundfos pumps have been listed. Any other equivalent make and model pump can be used.
2. Header pipes A and B are assumed to have a maximum length of 5 metres each. If these lengths are increased system output may be reduced.
3. Supply and discharge pipes C are assumed to have a combined maximum length of 2 metres. If these lengths are increased system output may be reduced.
4. The piping layout is assumed to be the same as depicted in Figure 8.7. Deviations from this layout (such as additional bends) may reduce system output.
5. These piping and pump specifications will enable maximum output of the REU-V2632WC water heaters when preset to deliver 75°C with the ambient water temperature not exceeding 25°C resulting in a minimum temperature rise of 50°C across the water heater.

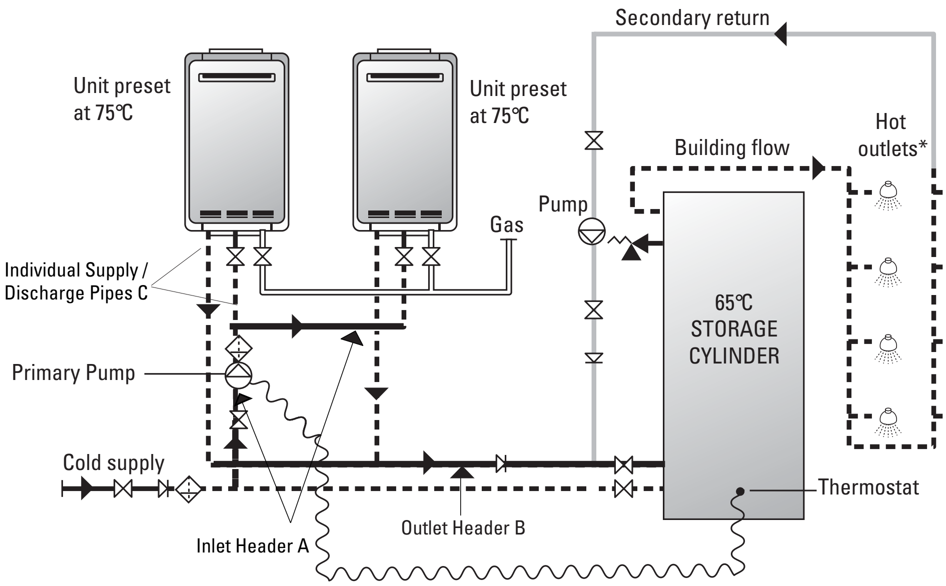


Figure 8.7: Water Pipe Sizing Schematic using REU-V2632WC units with storage cylinder.

e) Materials for Hot Water Piping

The following materials are authorised for use in hot water installations in Australia:

- Copper tubes manufactured in accordance with AS 1432 - 1996.
- Polybutylene (PB) manufactured in accordance with AS 2642.2 - 1994
- Cross-linked polythylene (PE-X) manufactured in accordance with AS 2492 - 1994.
- Polypropylene (PP) manufactured in accordance with AS 3500.1.2 - 1998.
- Stainless steel manufactured from alloy type 304 or 316 in accordance with AS 1769 -1975.

8.10 Sizing Gas Pipelines

Appendix F of AS5601/AG 601 - 2002 sets out the requirements for sizing of consumer piping, so that each appliance shall have a minimum pressure of 1.13 kPa for NG and 2.75kPa for LPG at the appliance inlet with all other appliances operating as per Table 4.1 of AS5601/AG 601 - 2002.

Table 8.10 contains selected charts from Appendix F of AS5601/AG 601 - 2002. Determine the length of the main run (from meter to furthermost appliance) and the total maximum gas load in MJ/h to find the appopriate gas pipe size.

The complete AS5601/AG 601 - 2002 - Gas Installations is available from Standards Australia.

Table 8.10: NG: National Pipe Sizing Chart - Copper Pipe. This chart is reproduced from AS5601/AG601 - 2002.

Length of straight pipe in metres

		2	4	6	8	10	12	14	16	18	20	25	30	35	40	45	50	55	60	65	70	75	80
Victoria - South Australia - Queensland																							
Supply Pressure 1.13kPa	20mm Copper	205	137	108	95	87	80	75	71	67	64	58	53	45	40	35	32	29	26				
.075kPa Pressure drop	25mm Copper	466	313	247	209	184	165	151	141	134	128	116	108	100	95	90	86	82	79	76	74	70	66
Table F1 AS5601 - 2002	32mm Copper	912	614	486	412	362	326	298	276	257	242	213	191	177	168	159	152	146	141	136	131	127	124
	40mm Copper	1559	1052	834	708	622	560	513	475	443	417	367	330	301	279	260	245	231	222	214	207	201	196
	20mm Copper	752	508	403	342	301	271	248	230	215	202	177	160	146	135	126	119	112	107	102	99	96	94
Supply Pressure 2.75kPa	25mm Copper	1691	1145	911	774	682	614	563	521	487	459	404	364	333	308	288	271	256	244	233	223	214	206
.75kPa Pressure drop	32mm Copper	3281	2227	1773	1508	1330	1199	1099	1019	953	897	790	712	652	604	565	532	503	479	457	438	421	406
Table F4 AS5601 - 2002	40mm Copper	5577	3791	3022	2572	2269	2047	1877	1740	1628	1534	1352	1219	1117	1035	968	911	863	821	784	752	723	696
NSW																							
Supply Pressure 1.38kPa	20mm Copper	409	275	218	184	162	146	133	123	115	108	98	91	85	80	76	73	70	67	65	62	61	59
.25kPa Pressure drop	25mm Copper	925	624	495	420	369	332	304	281	263	247	217	195	179	165	154	145	139	134	130	125	122	118
Table F3 AS5601 - 2002	32mm Copper	1801	1218	968	821	723	652	579	553	516	486	427	385	352	326	304	286	271	257	246	235	226	218
	40mm Copper	3070	2079	1654	1405	1238	1116	1022	947	886	834	734	661	605	560	523	493	466	443	423	405	389	375
	20mm Copper	1125	761	605	514	453	408	374	346	324	305	268	241	221	204	191	180	170	161	154	148	142	137
Supply Pressure 2.75kPa	25mm Copper	2522	1712	1364	1160	1022	922	845	783	733	690	608	547	501	464	434	409	387	368	351	337	324	312
1.5kPa Pressure drop	32mm Copper	4885	3323	2649	2255	1989	1796	1646	1527	1429	1346	1186	1070	980	908	849	800	758	721	689	660	634	611
Table F5 AS5601 - 2002	40mm Copper	8291	5648	4508	3839	3389	3060	2807	2604	2437	2297	2025	1827	1675	1553	1453	1369	1296	1234	1179	1130	1087	1048
Western Australia																							
Supply Pressure 1.38kPa	20mm Copper	269	180	142	120	106	98	92	87	82	79	71	66	61	58	55	51	46	42	39	36	34	32
.12kPa Pressure drop	25mm Copper	610	410	325	275	242	217	199	184	172	161	142	132	123	116	111	106	101	97	94	91	88	86
Table F2 AS5601 - 2002	32mm Copper	1190	803	637	540	475	427	391	362	338	318	279	251	230	212	198	186	179	172	166	161	156	152
	40mm Copper	2032	1373	1091	926	815	734	672	622	581	547	481	433	396	366	342	322	304	289	276	264	254	245
	20mm Copper	1125	761	605	514	453	408	374	346	324	305	268	241	221	204	191	180	170	161	154	148	142	137
Supply Pressure 2.75kPa	25mm Copper	2522	1712	1364	1160	1022	922	845	783	733	690	608	547	501	464	434	409	387	368	351	337	324	312
1.5kPa Pressure drop	32mm Copper	4885	3323	2649	2255	1989	1796	1646	1527	1429	1346	1186	1070	980	908	849	800	758	721	689	660	634	611
Table F5 AS5601 - 2002	40mm Copper	8291	5648	4508	3839	3389	3060	2807	2604	2437	2297	2025	1827	1675	1553	1453	1369	1296	1234	1179	1130	1087	1048

Table 8.11: LPG: National Pipe Sizing Chart - Copper Pipe.

Pressure Drop of 0.25kPa
LP Gas flow through Copper Pipe
Table F29 AS5601 - 2002
(MJ/h)

Length of straight pipe in metres

Supply Pressure 3 kPa
0.25 kPa Pressure drop

	2	4	6	8	10	12	14	16	18
20mm Copper	725	491	390	331	291	262	240	223	208
25mm Copper	1628	1104	879	747	659	594	544	504	472
32mm Copper	3155	2145	1709	1454	1283	1157	1061	984	920
40mm Copper	5358	3647	2909	2477	2186	1974	1810	1679	1571

	20	25	30	35	40	45	50	55	60
20mm Copper	196	172	155	142	131	123	115	109	104
25mm Copper	444	391	352	322	299	279	263	249	236
32mm Copper	867	764	689	631	585	547	515	487	464
40mm Copper	1481	1305	1177	1079	1000	936	881	835	794

	65	70	75	80
20mm Copper	99	95	91	88
25mm Copper	226	216	208	200
32mm Copper	443	425	408	393
40mm Copper	759	728	699	674

9

CHAPTER NINE

Calculations and Data

9.1 Legend

J	=	Joule
kJ	=	Kilojoule
MJ	=	Megajoule
kW	=	Kilowatt. Equivalent to kJ/Second
Cw	=	Specific Heat of Water. Is the energy required to raise the temperature of 1kg of water by 1 degree Celsius (kJ/kg°C)
H	=	Heat energy into water
M	=	Mass of Water
ΔT	=	Temperature rise
Q	=	Water heater power output
F	=	Flow rate of water
A	=	Internal cross sectional area of the pipe in m^2
V	=	Velocity of water in the pipe (m/second)
N	=	Newton
Π	=	Pi (3.142)
m^2	=	Square metres
m^3	=	Cubic metres
Q	=	Pipework heat loss

9.2 Formula Summary

Formula 1: $C_w = 4.2$ (kJ/kg°C)

Formula 2: $H = M \times C_w \times \Delta T$

Formula 3: $\Delta T = \dfrac{H}{M \times C_{water}}$

Formula 4: $\text{Time (s)} = \dfrac{\text{Heat energy required (kJ)}}{\text{Rate of energy input to the water (kW)}}$

Formula 5: One Kilojoule per second (kJ/s) = One Kilowatt (kW)

Formula 6: 1 MJ/h = 0.278 kW

Formula 7: 1 kW = 3.6 MJ/h

Formula 8: $\text{Recovery Rate (L/sec)} = \dfrac{\text{Heater Output (kW)}}{C_{water} \times \Delta T}$

Formula 9:

$\text{Quantity of Mixed Water} = \dfrac{\text{Quantity of hot water x temp rise from cold to hot}}{\text{Temperature rise from cold to mixed water}}$

$\text{Quantity of Hot Water} = \dfrac{\text{Quantity of mixed water x temp rise from cold to mixed}}{\text{Temperature rise from cold to hot water}}$

Formula 10: $F = A \times V$

Formula 11:

$\text{Secondary Recirculating Pump Flow Rate (L/sec)} = \dfrac{Q \times 10^{-3}}{4.2 (t1 - t2)}$ (Q in Watts)

9.3 Heat Measurement

Heat, also referred to as thermal energy, is a form of energy which is transferred from one body (solid, liquid or gas) to another body at a lower temperature by virtue of the temperature difference between the bodies.

In regards to the Rinnai V-Series hot water system, heat released due to the combustion of gas is transferred from the burner to the heat exchanger and then from the heat exchanger to the water being heated.

The SI unit of energy is the joule (J), which is the work done when a force of 1 Newton (N) acts through a distance of 1 metre (m) in the direction of the force, or when a mass of 1 kilogram (kg) is accelerated to a speed of 1 metre per second (m/s).

1000 Joules = 1 kilojoule, or

1000 J = 1 kJ **Equation 1**

1000 Kilojoules = 1 megajoule, or

1000kJ = 1 MJ **Equation 2**

It requires 4.186 kilojoules of heat energy to raise the temperature of 1 kg of water by 1 Degree Celsius (°C). This is known as the Specific Heat of Water (Cwater). Its units of measurement are 'kilojoules per kilogram per degree celsius' (kJ/kg °C). For most practical applications one litre of water weighs one kg.

Cwater = 4.186 (kJ/kg°C)

This is usually rounded off to:

Cwater = 4.2 (kJ/kg°C) **Formula 1**

The quantity of heat energy required to heat a given mass of water is calculated as follows:

Heat Energy (H) = Mass of Water (M) x Cwater x Temperature rise (Δ T)

or

H = M x Cwater x ΔT **Formula 2**

Example (1)
Calculate the heat energy required to raise 1000 kg (1000 litres) of water from 15°C to 65°C.

H = 1000 x 4.2 x (65 – 15)

H = 210,000 kJ

H = 210 MJ

Example (2)

Calculate the Temperature Rise (Δ T) when 100 litres of water is heated by the addition of 15 MJ of heat energy

From Equation 2: 15 MJ = 15,000 kJ

By transposing Formula 2 we obtain:

$$\Delta T = \frac{H}{M \times C_{water}}$$ **Formula 3**

$$\Delta T = \frac{15,000}{100 \times 4.2}$$

$$\Delta T = 35.7°C$$

If the initial temperature was 20°C the temperature as a result of adding the 15MJ of heat energy would be (20 + 35.7) = 55.7°C.

9.4 Heat Up Time

The time required to heat a quantity of water is calculated by:

$$\text{Time (s)} = \frac{\text{Heat energy required (kJ)}}{\text{Rate of energy input to the water (kW)}}$$ **Formula 4**

The rate of energy input into the water or water heater output (H) is usually expressed in Kilojoules per second (kJ/s). A Kilojoule per second is known as a Kilowatt.

One Kilojoule per second (kJ/s) = One Kilowatt (kW) **Formula 5**

The rate of energy usage of gas appliances is usually expressed in MJ/Hour.

To convert from Megajoules per hour (MJ/h) to Kilowatts (kW) divide by 3.6.
Conversely, to convert from kW to MJ/hour, multiply by 3.6.

From the above:

1 MJ/h = 0.278 kW **Formula 6**

1 kW = 3.6 MJ/h **Formula 7**

Example 1

A water heater has an energy input of 199 MJ/h and a thermal efficiency of 85.4% (that is, it converts 85.4% of the heat energy provided to it into useful heat for water heating). Calculate the time taken to heat 300 litres of water from 15°C to 65°C.

From **Formula (2):**

$H = M \times C_{water} \times \Delta T$

$H = 300 \times 4.2 \times (65 - 15)$

H = 63,000 kJ

From **Formula (6):**

$$\frac{199 \text{ MJ/h}}{3.6} = 55.2 \text{ kW}$$

With a thermal efficiency of 85.4%, rate of energy input into the water
= 55.2 x 0.854 = 47.1 kW

From **Formula 4:**

$$\text{Time} = \frac{63{,}000}{47.1}$$

Time = 1337 Seconds = 22 Minutes

9.5 Recovery Rate

The quantity of water that can be heated to a certain temperature in a given interval of time is known as the recovery rate.

It is calculated as follows:

$$\text{Recovery Rate (L/sec)} = \frac{\text{Heater Output}}{C_{water} \times \Delta T}$$ **Formula 8**

Example 1:

A water heater has an energy input of 199 MJ and a thermal efficiency of 85.4%. How many litres of water per hour can be raised from 15°C to 65°C?

From Formula (7):

$$\frac{199 \text{ MJ/Hr}}{3.6} = 55.2 \text{ kW}$$

With a thermal efficiency of 85.4%,
Rate of energy input into the water (H) = $55.2 \times \frac{85.4}{100} = 47.1$ kW

From **Formula 8,**

Recovery Rate (L/sec) = $\frac{\text{Heater Output (kW)}}{\text{Cwater} \times \Delta T}$

Recovery Rate = $\frac{47.1}{4.2 \times (65 - 15)}$

= 0.22 Litres per second

= 13.2 L/min

= 792 L/hour

9.6 Quantity of Mixed Water

The quantity of mixed water produced from a given volume of hot water is calculated from the formula

Mixed Water flow rate = $\frac{\text{Hot water flow rate} \times \text{temp rise from cold to hot}}{\text{Temperature rise from cold to mixed water}}$ **Formula 9**

Example:

1. Water is required at 43.5°C for ablutionary purposes. A water heater produces 26 L/min of hot water at 55°C. With an incoming cold water temperature of 15°C specify the amount of water available at 43.5°C.

Mixed Water (at 43.5°C) = $\frac{26 \times (55 - 15)}{43.5 - 15}$

= 36.5 L/min

2. 1,000 litres of mixed water is required at 45°C for photographic processing. Calculate the required amount of hot water at 60°C when the incoming cold water is 15°C.

Transposing **Formula 9:**

$$\text{Quantity Hot water} = \frac{\text{Quantity of mixed water x temperature rise from cold to mixed water}}{\text{Temperature rise from cold to hot water}}$$

$$\text{Hot Water} = \frac{1000 \times (45 - 15)}{60 - 15}$$

$$= \frac{30{,}000}{45}$$

$$= 666 \text{ litres}$$

9.7 Flow of Water through a Pipe

The flow of water through a pipe is calculated as follows:

$$F = A \times V \qquad \textbf{Formula 10}$$

where F = flow in cubic metres/sec (m^3/sec)
A = Internal cross-sectional area of the pipe in m^2
V = Velocity of water in the pipe (m/sec)

Example 1:

What is the flow rate of water in a 20 mm copper tube when the velocity in the pipe is 3m/sec. (Internal diameter of this pipe is 17.01 mm = 0.01701 m).

$$A = \frac{\Pi \times \text{Diameter}^2}{4}$$

$$A = \frac{3.142 \times 0.01701^2}{4} = 0.000227 \text{ m}^2$$

From Formula 10:

$F = A \times V$

$F = 0.000227 \times 3$

$= 0.00068 \text{ m}^3\text{/second}$

A volume of 1 m^3 is the same as 1000 litres.

hence

F = 1000 x 0.00068 = 0.68 L/sec

What is the velocity in the above pipe when the desired flow is 0.4 L/sec?

From **Formula 10:**

F = A x V

0.4 litres per second = 0.0004 m^3/s

then

$$V = \frac{F}{A}$$

$$V = \frac{0.0004}{0.000227}$$

$$V = 1.76 \text{ m/s}$$

9.8 Gas Authority Approval Calculations

State Authorities may have performance requirements for the energy used to heat a given quantity of hot water. Careful consideration should be given to the insulation of storage cylinders and associated pipe work to minimise heat losses.

The calculations involved are best illustrated by an example.

Example 1

A 20 Storey Building comprises the following:

- Levels 1–4 Reception and Carparking.
- Levels 5–15 Serviced Apartments.
- Levels 6–20 Apartments (Owner Occupied/Rented).

Both the lower and upper level apartments are to be supplied with hot water via 2 centralised hot water systems.

Zone 1 Serviced Apartments
- 22 1 bedroom apartments
- 56 2 bedroom apartments

From Table 7.2:
- Allow 50 litres for 1 bedroom apartments.
- Allow 75 litres for 2 bedroom apartments.

Hot Water Demand:

56 x 75	=	4200
22 x 50	=	1100
Total	=	5300 litres @ 60°C per peak hour.
	=	10600 litres per day assuming 2 peak hour periods.

Zone 2 Owner Occupied Apartments, Levels 16–20
- 9 x 1 bedroom apartments
- 18 x 3 bedroom apartments
- 6 penthouses with spa

From Table 7.2, the total demand is determined:

9 x 50	=	450
18 x 110	=	1980
6 x 150	=	900
Total	=	3330 litres @ 60°C per peak hour.
	=	6660 litres per day assuming 2 peak hour periods.

Tables 9.1 and 9.2 contain the calculations for determining the energy used to heat the hot water required in this application.

Table 9.1: Assessment of Domestic Hot Water System Heat Loss — Levels 5–15 (Levels 1–4 do not have a hot water requirement)

Assumptions	
Water circulation temperature	60 deg.C
Ambient – internal	15 deg.C
Ambient – external	10 deg.C
Water storage heat loss	3.2 MJ/hr
Water meter heat loss	2.7 MJ/hr
Water generation	0.277 MJ/litre
Total daily water consumption	10600 litres/day

Piping Arrangement

Pipe diameter	Insulation	Location	Length (metres)	Heat loss per metre	Heat Loss (Watts)
15		Internal			
20		Internal			
25	20 Armaflex	Internal	242	10.30	2493
32	20 Armaflex	Internal	360	11.65	4194
40	20 Armaflex	Internal	12	13.15	158
50	20 Armaflex	Internal	12	16.15	194
65	20 Armaflex	Internal	8	19.80	158
80	20 Armaflex	Internal	62	22.70	1407
100	20 Armaflex	External	8	30.50	244
Total					**8848**

Heat Loss		
Piping	8848 watts	764.5 MJ/day
Water storage	3.2 MJ/hr	76.8 MJ/day
Water meter	2.7 MJ/hr	64.8 MJ/day
Total Heat Loss		**906 MJ/day**
Water generation		**2936** MJ/day
Heat losses		**3842** MJ/day
Total Gas Consumption		**0.362** MJ/litre/day

This system would satisfy a 0.4 MJ/litre/day specification

Table 9.2: Assessment of Domestic Hot Water System Heat Loss — Levels 16–Roof

Assumptions

Water circulation temperature	60 deg.C
Ambient – internal	15 deg.C
Ambient – external	10 deg.C
Water storage heat loss	3.2 MJ/hr
Water meter heat loss	2.7 MJ/hr
Water generation	0.277 MJ/litre
Total daily water consumption	6660 litres/day

Piping Arrangement

Pipe diameter	Insulation	Location	Length (metres)	Heat loss per metre	Heat Loss (Watts)
15					
20	25 Armaflex	Internal	82	8.15	668
25	38 Fibreglass	Internal	80	6.20	496
32	38 Fibreglass	Internal	60	7.10	426
40	25 Armaflex	Internal	16	11.4	182
50	25 Armaflex	Internal	4	13.85	55
65	25 Armaflex	Internal	28	16.75	469
80	25 Armaflex	External	9	20.10	181
100	25 Armaflex	External	4	23.60	94
100	38 Fibreglass	External	4	16.60	66
Total					**2637**

Heat Loss

Piping	2637 watts	227.8 MJ/day
Water storage	3.2 MJ/hr	76.8 MJ/day
Water meter	2.7 MJ/hr	64.8 MJ/day
Total Heat Loss		**369.4 MJ/day**
Water generation		**1845** MJ/day
Heat losses		**2214.4** MJ/day
Total Gas Consumption		**0.33** MJ/litre/day

This system would satisfy a 0.4 MJ/litre/day specification

For additional information relating to heat loss refer to the Australian Institute of Refrigeration, Airconditioning & Heating (AIRAH) Handbook or the Institute of Plumbing Australia.

9.9 Conversion Factors

Table 9.3: Conversion Factors

To convert from	To		Multiply by
Btu	*to*	MJ	0.001055
kW	*to*	MJ	3.6
MJ	*to*	Btu	948
Btu	*to*	kW	0.000294
kW	*to*	Btu	3405
hp	*to*	kW	0.7457
kW	*to*	hp	1.341
kcal	*to*	MJ	0.004187
MJ	*to*	kcal	239
bar	*to*	kPa	100
kPa	*to*	bar	0.01
bar	*to*	Metres head	10.2
Metres head	*to*	bar	0.098
Metres head	*to*	kPa	9.8
psi	*to*	kPa	6.895
kPa	*to*	psi	0.145
Inches WG in H_2O	*to*	kPa	0.248
Pa	*to*	Inches WG in H_2O	0.004
mm H_2O	*to*	Pa	9.789
Gallon (Imp)	*to*	litre	4.546
Gallon (US)	*to*	litre	3.785
Gallon (Imp)/min	*to*	litres/second	0.76

9.10 Gas Specifications (Typical)

Table 9.4: Gas Specifications Table

	Heating Value MJ/m^3	Relative Density Kg/m^3
Natural Gas	38	0.6
LPG (Propane)	96	1.55

9.11 Physical Properties of LPG (Propane)

MJ/Litre Liquid	=	25.5 MJ/L Liquid
MJ/Kg Liquid	=	50.4 MJ/Kg Liquid
MJ/m^3 Vapour	=	96 MJ/m^3 Vapour
Litres/Tonne	=	1975 Litres/Tonne

9.12 Rinnai Running Costs

Example (1) Using Example 1 of Section 7.5.

A 6 storey development comprises

- 4 one bedroom units
- 5 two bedroom units
- 6 three bedroom units

Hot water requirement per day = 2 x 1235 = 2470 litres assuming 2 peak hour periods.

Assume this water is stored at 60°C and that the ambient temperature is 15°C.

Chapter 9.1 'Heat Measurement' Formula (2) states

$H = M \times Cwater \times \Delta T$

$H = 2470 \times 4.2 \times (65 - 15)$

$= 518,700$ kJ

Assume REU-V2632WC units are used which have a thermal efficiency of approximately 85.4%. (from Table 4.1). Then the amount of energy supplied to the units to heat the above quantity of water =

$$H = \frac{518700}{0.854} = 607377 \text{ kJ} = 607.4 \text{ MJ}$$

*Assuming Natural Gas cost @ 0.9 cents/MJ

Approximate cost per day = 607.4 x 0.9 = 547 cents

Approximate cost per year = 547x 365 = 199,655 cents

= $1,996.55

Example (2) Using Example 2 in Section 7.5.

In a sporting stadium change-room, 30 players shower for 8 minutes each from 10 x 12 litre/minute shower heads (showers are taken in groups of 10 people with a total shower time of 24 minutes). Showers are used 3 times a week for 48 weeks/year.

Assume that the V-Series hot water units are pre-set to deliver 50°C and that the ambient water temperature is 15°C. Assume that showering temperature is 42°C.

The hot water demand is 92.6 L/min at 50°C

From Figure 4.10, a REU-V2632WC will supply 19.2 L/min at a (50 – 15) = 35°C temperature rise.

Hence, in theory, the number of units required $= \frac{92.6}{19.2} = 4.8$

From Table 4.10, when supplying 19.2 L/min at a 35°C rise, an REU-V2632WC will use 199 MJ/h of gas.

Hence for 4.8 units the gas consumption is 4.8 x 199 = 955 MJ/h.

Hours of usage per year $= \frac{24}{60} \times 3 \times 48 = 57.6$ hours

Then, gas consumption per year = 57.6 x 955 = 55,008 MJ

* Assuming Natural Gas cost @ 0.9 cents/MJ

Approximate Cost per year = 55008 MJ x 0.9c/MJ = 49,507 cents

Approximate Cost per showering session $= \frac{\$495.07}{3 \times 48} = \$3.44$

An alternative solution is as follows:

Quantity of hot water at 42°C per showering session = 10 x 12 x 24 = 2880 litres

Quantity of hot water at 42°C per year = 2880 x 3 x 48 = 414,720 litres

From Section 9.1, Formula (2), the quantity of energy required to heat 414,720 litres of water is calculated as follows:

H = 414,720 (L) x 4.2 x (42°C – 15°C)

H = 47,029,248 kJ

The REU-V2632WC has a thermal efficiency of approximately 85.4%. Then the amount of energy supplied to the units to heat the above quantity of water =

$$H = \frac{47,029,248}{0.854} = 55,069,377 \text{ kJ}$$

= 55,069.4 MJ

* Assuming Natural Gas cost @ 0.9 cents/MJ

Approximate Cost per year = 55069.4 MJ x 0.9c/MJ = $495.62

Approximate Cost per showering session $= \frac{\$495.62}{3 \times 48} = \$3.44$

This is the same as the previous solution.

9.13 Running Cost Comparisons:

In this Section the following energy tarriffs are assumed:

Electricity Tarriff (peak)	=	11.86 cents/kWh
Electricity Tarriff (off peak)	=	4.45 cents/kWh
Natural Gas Tarriff	=	0.9 cents/MJ

These tariffs are indicative only. Consult your local supplier for the actual tariffs in your area.

Assume 200 litres of hot water are used daily and that the hot water heater raises the temperature by 50°C.

a) Gas Continuous Flow Vs Electric Storage

Assume that a 250 litre Electric Domestic hot water heater is used and the hot water demand is 200 litres per day at a 50°C rise. Assume that the energy used per day (E) = 14.0 kWh.

Cost per day (peak)	=	14.0 x 11.86 cents
	=	166 cents
	=	$1.66

Cost per year (assuming 365 days per year usage) = $1.66 x 365 = $605.90

Cost per day (off peak)	=	14.0 x 4.45 cents
	=	62.3 cents
	=	$0.62

Cost per year (assuming 365 days per year usage) = $0.62 x 365 = $226.30

b) Gas Continuous Flow Cost

From Section 9.1 Formula (2) states:

$H = M \times Cwater \times \Delta T$

$H = 200 \times 4.2 \times 50$

$H = 41{,}900$ kJ

Assume a REU-V2632WC is used. This model has a thermal efficiency of 85.40%

Heat energy supplied to the hot water heater (kJ) = 41,900 / 0.854

= 49,063 kJ

= 49.06 MJ

Cost per Day (Natural Gas) = 0.9 x 49.06 = 44.2 cents

Cost per year (assuming 365 days per year usage) = 365 x $0.44 = $160.60

c) Gas Storage Cost

Assume that an average efficiency 260 litre Domestic Outdoor storage gas hot water heater is used and the hot water demand is 200 litres per day at a 50°C rise. Assume that the energy used per day = 79 MJ.

Energy used per day = 82 MJ

Cost per Day (Natural Gas) = 0.9 x 82 = 73.8 cents

Cost per year (assuming 365 days per year usage) = 365 x $0.74 = $270.10

Assume that a high efficiency 360 litre Domestic storage gas hot water heater is used and the hot water demand is 200 litres per day at a 50°C rise. Assume that the energy used per day = 63 MJ.

Energy used per day = 63 MJ

Cost per Day (Natural Gas) = 0.9 x 63 = 56.7 cents

Cost per year (assuming 365 days per year usage) = 365 x $0.57 = $208.05

d) Running costs comparison summary

The running costs for the various water heaters are summarised in Table 9.5 below: The 'savings' column compares running costs of a V Series heater to other types of hot water units. This table shows there is a 24% running cost saving using a Rinnai V-Series water heater even when compared to a high efficiency storage system.

Table 9.5: Running costs comparisons

System Type	Approx. Running Cost per Year	Approx. Savings per Year	Approx. Savings %
Electric Peak - Storage	$601	$449	73%
Electric Off Peak – Storage	$226	$69	29%
Natural Gas – Storage (average efficiency)	$270	$113	41%
Natural Gas – Storage (high efficiency)	$208	$51	23%
Natural Gas – V-Series Continuous Flow	$161	N/A	N/A

9.14 Australian Ambient Water Temperature Ranges

The temperatures are in degrees Celsius and represent the highest and lowest range between summer and winter over a twelve month period.

10

CHAPTER TEN

Installation Examples

10.1 Bell Centre

- Pump & Electrical Engineering Services, Commercial Pack Model: CP30, Pressure Responsive System (PRS).
  Servicing a 400 Room Student Accommodation complex.

Figure 10.1: Bell Centre

10.2 Summit Concierge Apartments

- Pump & Electrical Engineering Services, Commercial pack model CP22, Pressure Responsive System (PRS)
  Servicing 200 Apartments.

Figure 10.2: Summit Concierge Apartments

10.3 Scala Apartments

- Demand Duo Commercial pack model, 2 x DD5 32/250 servicing 100 Apartments.

Figure 10.3: Scala Apartments

10.4 The Mews Retirement Village

- Rinnai External Manifold Pack model MP7. Servicing a 64 bed nursing home in Melbourne

Figure 10.4: The Mews Retirement Village

10.5 Murphy Reserve

- Rinnai Internal Manifold Pack, Model MP-4.
  Servicing 10 x 8 L/min. showers simultaneously.

Figure 10.5: Murphy Reserve

10.6 A Prestigious Golf Club in Melbourne

- Rinnai Manifolded Pack, Model MP8. Servicing 10 x 19 L/min. showers simultaneously.

Figure 10.6: A Presitgious Golf Club in Melbourne

10.7 Federation Square

- Demand Duo Manifold Pack, model DD3. Servicing a restaurant located at the Federation Square Complex.

Figure 10.7: Federation Square

10.8 South Yarra Hills Suites

- Pump & Electrical Engineering Services, Commercial Pack, model CP6, Tempered Water system, providing 50 degree hot water to 60 serviced apartments.

Figure 10.8: South Yarra Hills Suites

10.9 Waverley Inn

- Pump & Electrical Engineering Services, Commercial Pack, Model SP5, (PRS) Tempered Water system, providing 50° C hot water to 40 hotel suites.

Figure 10.9: Waverley Inn

11

CHAPTER ELEVEN

Packaged Hot Water Systems

11.1 Packaged Hot Water Systems

Packaged hot water systems using the V-Series water heaters are now available from various suppliers including Pump and Electrical Engineering Services based in Victoria and Demand Duo based in South Australia. Descriptions of these systems are shown below. Examples of actual installations using these systems are shown in Chapter 9.

Continuous Flow / Temperature Regulated / Pressure Controlled Heated Water System

This system is designed and built by Pump and Electrical Engineering Services based in Victoria. This system provides water at mains pressure without using a storage tank.

Principle of Operation:
Water regulation pump(s) capable of supplying water at a set pressure over varying flow rates is plumbed to/from the water Inlet / Outlet of the Continuous Flow Water Heater (CFWH).
The pressure of the heated water leaving the CFWH is continuously monitored to provide a positive feedback of actual pressure which is compared to the set pressure reference. This comparison determines the water regulation pump(s) rate of charge into the heated water reticulation system, being a variable dependent on the flow requirements as created by usage.The water regulation pump(s) are also utilized to: Overcome friction losses inherent within the CFWH. Provide (if required) an adjustable flow rate for the circulation of water throughout the heated water reticulation system, so as to maintain a consistency of temperature throughout. To compensate flow during peak demand, should the heated water flow exceed the system capability, a 'Flow Compensating Device' has been provided. This device is installed between Cold Water Inlet and Heated Water. Outlet of the system to automatically provide additional water flow. This principle of operation is as per conventional tank systems.
Unique Features:
* Operation and speed of the water regulation pump(s) being controlled by pressure and not temperature.
* Heated water within the reticulation system can be supplied at a required constant water pressure.
* Separate circulating pump(s) and Hot water storage cylinder(s) are no longer required.
Patent Application No:44396/02

Benefits:
* Can be guaranteed heated water at a: set temperature in relation to a specified flow rate.
* Constant pressure over specific flow rates.
* Peak Demand Flow Compensation
* Circulation flow rate (adjustable) to ensure consistency of temperature throughout the heated water reticulation system.
* Energy saving:
*Water is only heated as per usage (with the exception of circulated water)
*No energy consumed as in systems utilizing vessels for storing hot water.

Figure 11.1: Pump and Electrical Engineering Services - Continuous Flow/Temperature Regulated Pressure Controlled Heated system

11.2 Demand Duo Systems

Range Features and Benefits

- Mains pressure hot water with energy efficient heating.
- Rinnai 5 star hot water units with approved above MEPS standard purpose with stainless steel tank.
- Concealed pump, electronic digital display thermostat and pipework
- 32 mm circulating connection
- 20 mm 850 kPa temperature pressure relief valve
- 32 mm inlet and outlet connection
- Internal and external models
- Standard mains pressure installation
- Minimal floor space required
- Easy installation - minimal time
- Concealed separate inlet and two outlet connections from Rinnai and stainless steel tank
- Easy replacement of existing traditional installations

Figure 11.2: Demand Duo

Figure 11.3: Demand Duo Options

Figure 11.4: Demand Duo skid mounted systems

11.3 Manifold Packs

Rinnai Manifold packs consists of multiple Rinnai V-Series water heaters mounted on a rack complete with all plumbing and fittings for high water demand applications. Manifold packs with both internal and external V-Series water heaters are available.
Features and benefits are as follows:

- Any number of V-Series water heaters can be manifolded.
- Subs left or right hand installation.
- Floor or wall mounted.
- Quality fittings used throughout, including flexible hoses for easy assembly/disassembly of V-Series water heaters.
- Insulated pipework.

Table 11.1: Manifold Packs

* The base units MP2 (2 water heaters) and MP3 (3 water heaters) are combined to create larger systems, such as MP4 (MP2 + MP2), MP5 (MP2 + MP3), MP6 (MP3 + MP3) etc.

Manifold Pack model numbers	Dimensions						Options
INTERNAL UNITS	Heights		Width	Depth	Foot Print Dimensions		
(Figure 11.6)	A	B	C	D	1	2	
MP2	1820 mm	1800 mm	650 mm	265 mm	150 mm	500 mm	Floor mounting kit. GPO and Pump kit. PAM or MECS.
MP3	1820 mm	1800 mm	1000 mm	265 mm	150 mm	500 mm	Floor mounting kit. GPO's and Pump kit, PAM or MECS.
MP4 *	1820 mm	1800 mm	1360 mm	265 mm	150 mm	500 mm	Floor mounting kits. GPO's and Pump Kit. PAM or MECS.
MP5 *	1820 mm	1800 mm	1710 mm	290 mm	150 mm	500 mm	Floor mounting kits. GPO's & Pump Kit. PAM or MECS.
MP6 *	1820 mm	1800 mm	2060 mm	290 mm	150 mm	500 mm	Floor mounting kits. GPO & Pump kit.

Manifold Pack model numbers	Dimensions						Options
EXTERNAL UNITS	Heights		Width	Depth	Foot Print Dimensions		
(Figure 11.5)	A	B	C	D	1	2	
MP2	Not Applicable	1800 mm	650 mm	265 mm	150 mm	500 mm	Floor mounting kit. GPO and Pump kit. PAM or MECS.
MP3	Not Applicable	1800 mm	1000 mm	265 mm	150 mm	500 mm	Floor mounting kit. GPO's and Pump kit, PAM or MECS.
MP4 *	Not Applicable	1800 mm	1360 mm	265 mm	150 mm	500 mm	Floor mounting kits. GPO's and Pump Kit. PAM or MECS.
MP5 *	Not Applicable	1800 mm	1710 mm	290 mm	150 mm	500 mm	Floor mounting kits. GPO's & Pump Kit. PAM or MECS.
MP6 *	Not Applicable	1800 mm	2060 mm	290 mm	150 mm	500 mm	Floor mounting kits. GPO & Pump kit.
Warranty	Pump: 1 Year Pipes: 10 Years Flexibles: 10 Years Others: 10 Years						

External Manifold Pack (Three V-Series External Water Heaters shown).

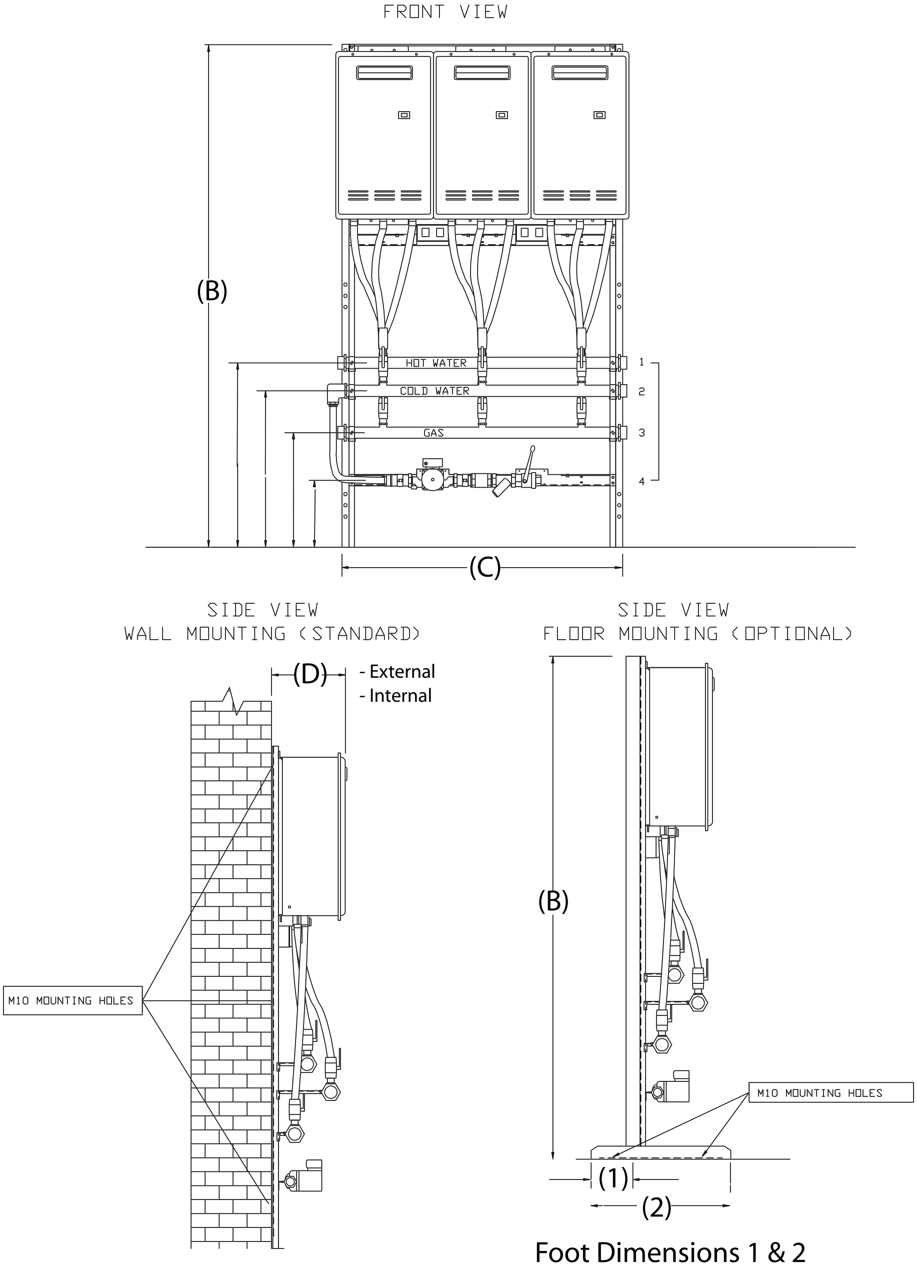


Figure 11.5: External Manifold pack

Internal Manifold Pack (Three V-Series External Water Heaters shown).

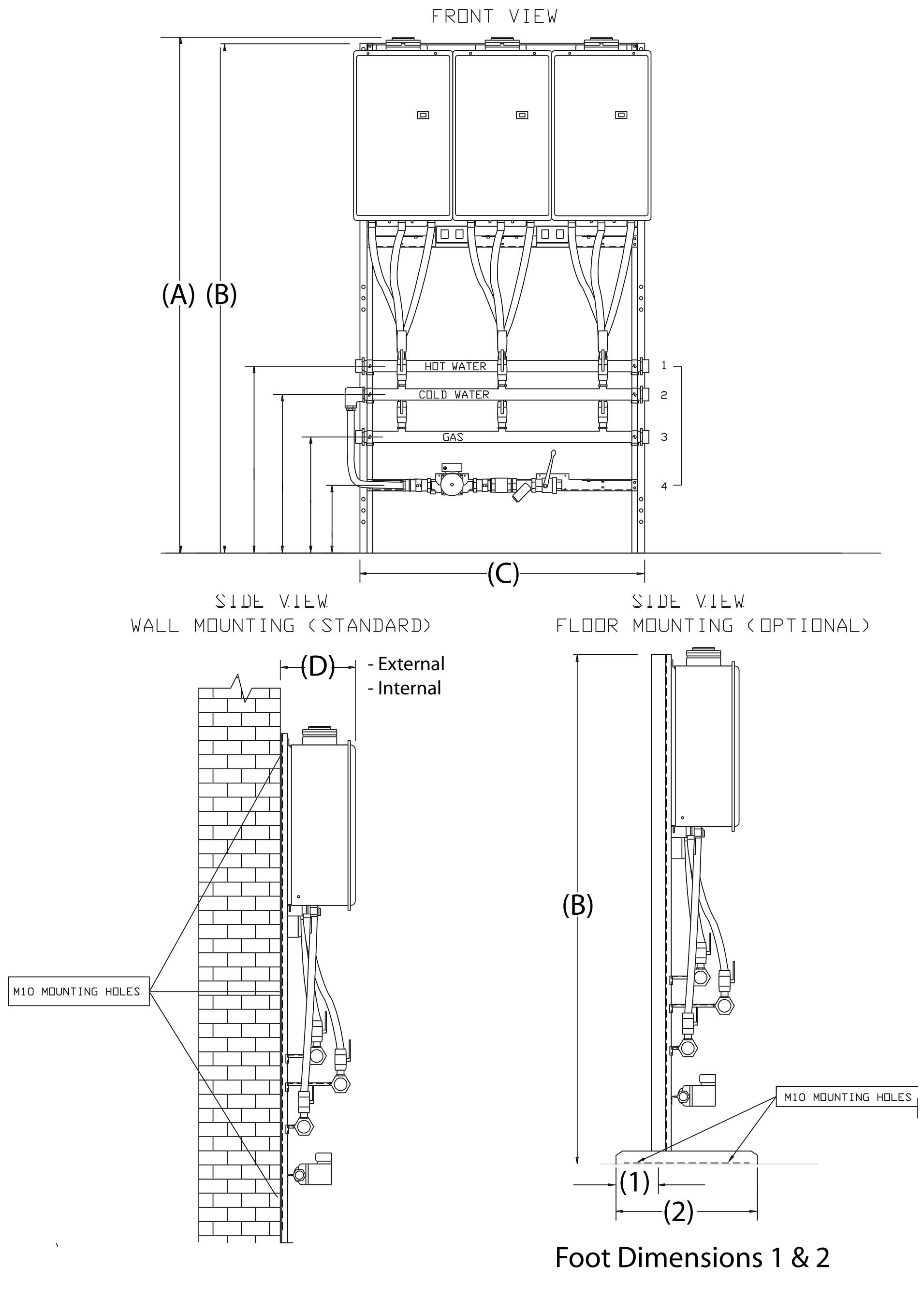


Figure 11.6: Internal Manifold pack

11.4 Hydronic Heating

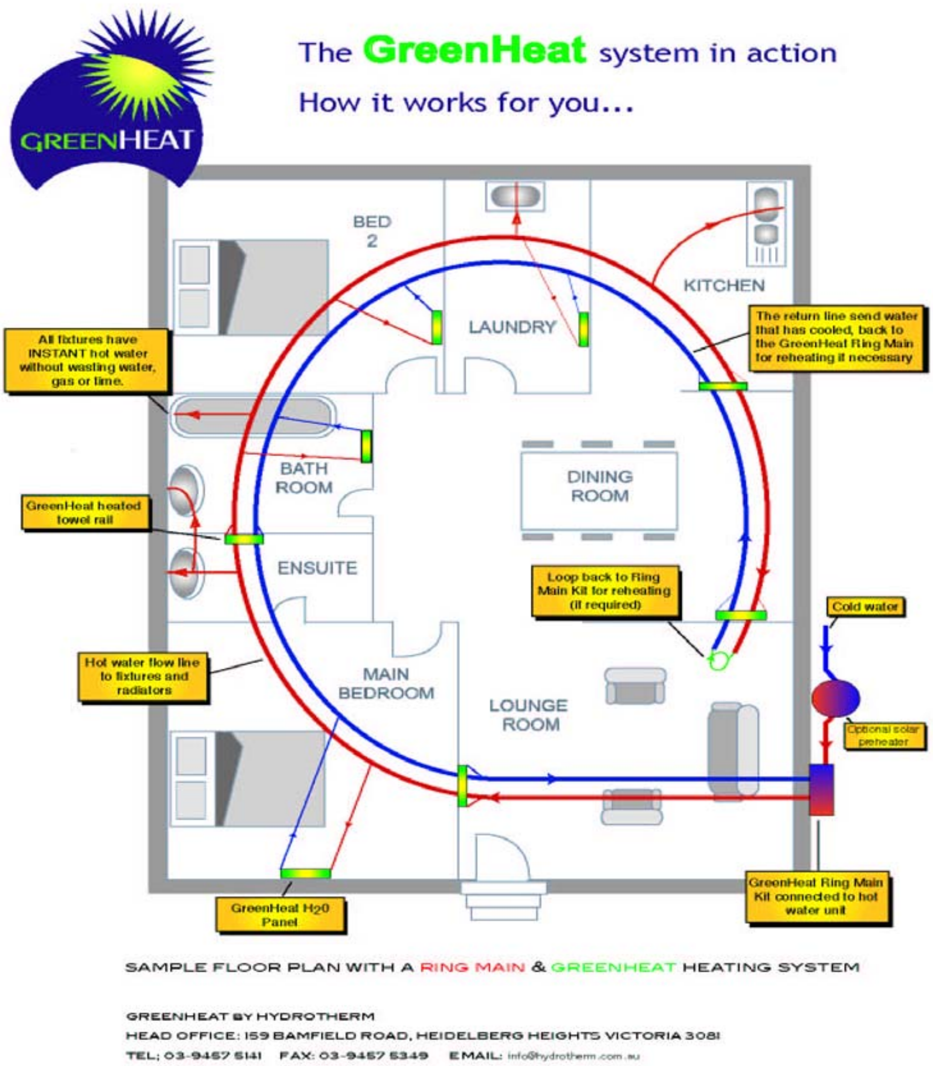


Figure 11.7: Hydrotherm Greenheat Hydronic Heating Schematic

Table 11.2: Hydrotherm Greenheat Hydronic Heating Room Sizing & Radiator Sizing

Room sizing and radiator capacity (approximate only)

Room size	2 metres	3 metres	4 metres	5 metres	6 metres	7 metres
2 metres	0.4 kW	0.6 kW	0.8 kW	1.0 kW	1.2 kW	1.4 kW
3 metres	0.6 kW	0.9 kW	1.2 kW	1.5 kW	1.8 kW	2.1 kW
4 metres	0.8 kW	1.2 kW	1.6 kW	2.0 kW	2.4 kW	2.8 kW
5 metres	1.0 kW	1.5 kW	2.0 kW	2.5 kW	3.0 kW	3.5 kW
6 metres	1.2 kW	1.8 kW	2.4 kW	3.0 kW	3.6 kW	4.2 kW
7 metres	1.4 kW	2.1 kW	2.8 kW	3.5 kW	4.2 kW	4.9 kW

Radiator sizing (Temperature Output of Rinnai Infinity set at 65°C)

Item No.	Height x Width	Kilo Watt heat Output
G 4001480	400 mm x 1480 mm	1.1 kW
G 4001960	400 mm x 1960 mm	1.5 kW
G 6001000	600 mm x 1000 mm	1.1 kW
G 6001480	600 mm x 1480 mm	1.6 kW
G 900600	900 mm x 600 mm	1.0 kW
G 900760	900 mm x 760 mm	1.2 kW
G 9001000	900 mm x 1000 mm	1.6 kW
G 991320	900 mm x 1320 mm	2.0 kW
G 1500360	1500 mm x 360 mm	1.0 kW
G 1500600	1500 mm x 600 mm	1.6 kW
GHR/600 Bathroom Model	1830 mm x 600 mm	1.1 kW
GR3/600 Laundry Model	1830 mm x 600 mm	0.6 kW

Refer to Hydrotherm Australia Pty Ltd for further information

HYDROTHERM
AUSTRALIA PTY LTD

159 BAMFIELD ROAD
HEIDELBERG HEIGHTS 3081
Phone: (03) 9457 5141 Fax: (03) 9457 5349

Ceiling Loop

Pump Kit

Thermostat

V-Series water heater and pump kit installation

Radiator Range

Figure 11.8: Hydrotherm Greenheat Hydronic Heating Components

12

CHAPTER TWELVE

If you Need Assistance

12.1 Error Codes

Rinnai V Series Commercial hot water heaters have the ability to check their own operation continuously. If a fault occurs, an Error Message will flash on the digital monitor of the remote controls. This assists with diagnosing the fault and may enable you to overcome a problem without a service call. If enquiring about service, please quote the code displayed.

Table 12.1: Error Codes

Code Displayed	Fault	Remedy
-	Noticeable reduction in water flow	Inlet water filter needs to be cleaned. Service call.**
03	Power interruption during Bath fill (water will not flow on power reinstatement)	Turn off all hot water taps. Press ON/OFF twice.
10	Air intake or flue blocked	Service Call
11	No ignition / No gas supply	Check gas is turned on at water heater and gas meter or cylinder. * **
12	Flame Failure / Low gas flow	Check gas is turned on at water heater and gas meter or cylinder. Check that nothing is obstructing flue outlet. Turn on gas supply to water heater.*
14	Remaining Flame Safety Device	Service Call
16	Over Temperature Warning	Service Call
32	Outgoing Water Temperature Sensor Faulty	Service Call
33	Heat Exchanger Outlet Sensor Faulty	Service Call
52	Gas Modulating Valve Faulty	Service Call
61	Combustion Fan Failure	Service Call
65	Water Flow Control Faulty (does not stop flow properly)	Service Call
71	Micro-processor Failure	Service Call
72	Micro-processor Failure	Service Call

* In all cases, you may be able to clear the Error Code simply by turning the hot water tap OFF, then ON again. If this does not clear the Error Code, try pushing the ON/OFF button OFF, then ON again. If the Error Code still remains, contact Rinnai or your nearest service agent for advice.
** Faults caused by insufficient gas/water supply or gas/water quality and installation errors are not covered by the manufacturer's warranty.