PLATEflow

Hot Water Cylinders with External Plate Heat Exchanger

Installation & Technical Manual

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PLATEflow Installation & Technical Manual

Manual should be left with PLATEflow or O & M manuals
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1.0 Introduction

McDonald Water Storage offer an extensive range of cylinders to suit vented and unvented installations for commercial and industrial use. Manufactured in strict accordance to the requirements of British Standard 853 and quality plan ISO 9001, we have the ability to manufacture cylinders to a capacity of over 3000 Litres and have a long history of manufacturing copper cylinders tailored to the exact requirements of the project. From schools, universities, football clubs, hotels, hospitals, factories, swimming pools to offshore platforms McDonald Water Storage cylinders and expertise have been used to meet a variety of demands in differing environments.

Our commitment to providing a knowledgeable, friendly service from conception to post-installation support, alongside our unrivalled ability to provide a bespoke cylinder package designed to your exact requirements will minimise the time and costs involved during installation.

Carrying a wide range of materials, McDonald Water Storage offer industry leading delivery times on projects, with a standard 2 Week delivery period and often quicker, cylinders can be delivered on-time when you need it.

2.0 Bespoke Cylinders

McDonald Water Storage have an enviable position in the hot water cylinder market for our ability to design, manufacture and supply some of the most complex and technical custom designed cylinders for specific applications. Being able to supply products made to individual specifications not only allows for a cylinder specifically tailored to your needs but also reduces the time and costs of installation, helping to save on your overall project cost.

Technical advice and in-house expertise are readily available to ensure a suitably tailored cylinder. Our aim is to ensure that our hot water cylinders are made to your individual specification to ensure you get exactly what you want.
3.0 Copper Shell Material

McDonald Water Storage manufacture their cylinders from premium grade solid copper. Copper material has been selected as the best material to use for many reasons. Tried and tested throughout the world for thousands of years, copper is a reliable and economical non-corrosive metal that is used extensively for hot water storage for its superior killing of germs, unrivalled heat conductivity, flexibility of manufacture and long-lifespan (Expected PLATEflow life in excess of 25 years).

Health

Copper will eradicate MRSA, E-coli and even Avian Bird Flu in less than 5 Hours. In tests it took 34 days for E-coli 0157 to die on Stainless Steel, 4 days on Brass and just 4 hours on Copper. 99% of the bacterial population, introduced into a copper plumbing system, will disappear in under five hours. Copper is recommended to combat Legionellae. Copper is a vital trace element in the human body and essential for good health.

Efficiency

Copper is one of the most efficient conductors of heat. It has a thermal conductivity of 401 W/mK. Compare this to Stainless Steel that is rated at 14 W/mK and you can see why copper is the material of choice. This is of vital importance when trying to get the most out of renewable technologies such as Solar and Geothermal. These require highly efficient coils to transfer their energy into hot water and copper maximises this heat transfer.

Versatility

Alongside its superior heat conductivity, copper is a strong material but can be easily formed into bends, coils and other shapes. This allows for more bespoke connections that other materials cannot provide.

Stainless Steel

In situations where a stainless steel tank is required (e.g. higher working pressures), McDonald Water Storage can offer a stainless steel option. All our stainless steel cylinders are pickled and passivated.
4.0 PLATEflow Design

4.1 Operation

The PLATEflow is designed to provide instantaneous hot water up to a steady flow rate. The following operations are illustrated in the sketch below:

**A** The Buffer Vessel is fed water from the cold feed, which is then pumped up through the Charging Pump, and Flow Limiting Valve and heated by the Plate Heat Exchanger. This heated water is fed to top of the Buffer Vessel.

**B** Any excess hot water is fed back into the Vessel, recharging the water temperature.

**C** Only when the hot water demand exceeds the steady flow rate of the Plate Heat Exchanger, is the water taken directly from the Buffer Vessel.

*The Secondary Return rate should not exceed the flow rate across the Plate Heat Exchanger.*
4.2 Heat Systems & Sources

Primary heating systems (e.g. Gas Boiler) will transfer heat through the external Plate Heat Exchanger to the opposing flow from the Buffer Vessel. With or without primary controls, it can be fitted with a charging pump and flow limiting valve to our PLATEflow unit. This can provide instantaneous hot water, with the additional fall back of a buffer vessel and an easily maintained/replaceable external heat exchanger.

Electric Immersion Heaters can be installed to act as a secondary heat source to the Buffer Vessel. When primary heat sources are not available, the Immersion Heater(s) will heat the water to temperatures set by their built-in/installed Control and High-Limit thermostats.
5.0 Specifying Plate Heat Exchanger Requirements

When specifying your PLATEflow, it is important to know what is required for your unit to provide the necessary hot water as efficiently as possible. Oversizing the cylinder can lead to unnecessary costs both in your PLATEflow cost and running of your system, while inadequate storage can lead to the system not meeting the users requirements.

The Buffer Vessel can vary in sizes, depending on the capacity demand during peak periods, as well as the available installation space. An advised kW input can be given once the required flow rates are provided.

The following list of information should be provided to help specify a suitable unit to meet your requirements:

- Steady Flow Rate (l/s)
- Peak Flow Rate (l/s)
- Peak Flow Time (mins)
- Boiler Flow and Return Temperatures (°C)
- kW Input (if known)
- Secondary System Pressure or Working Head (Bar)

5.1 PLATEflow Calculations

A Commercial Cylinder Sizing guide is available for public use on the PLATEflow page of the McDonald Water Storage website, but the formulas below can also be used to help calculate your PLATEflow requirements;

\[
\text{Peak Flow Rate} \left( \text{Litres/Second} \right) = \frac{\text{Peak Output (Litres)}}{\text{Peak Period (Seconds)}}
\]

\[
\text{Total Input Required (kW)} = \frac{\text{Total Output (Litres)} \times c_p \times \Delta T \left( ^\circ \text{C} \right)}{\text{Peak Period (Sec)}}
\]

\[
\text{Flow Rate} \left( \text{l/s} \right) = \frac{\text{Boiler Heat Load (kW)}}{c_p \times \Delta T \left( ^\circ \text{C} \right)}
\]

Where:

\( c_p = \) Specific Heat Capacity (4.187 kJ/kgK)
\( \Delta T = \) Rise in Temperature (°C)
5.2 **PLATEflow Plus**

The PLATEflow Plus includes primary controls and incorporates a Packaged PHE.

The Packaged PHE allows the user to fully control both the Primary and Secondary flows to meet the varying domestic hot water demands. There are different designs available to suit the control required, both for direct hot water control and indirect hot water control through a Buffer Vessel.

The standard design incorporates the following:

- Gasket Plate Heat Exchanger with AIS 316 stainless steel plates and clip-on gaskets
- 4 port modulating control valve
- Industrial quality temperature controller – fully programmable
- LCD digital display of system temperature and control set point
- High limit safety shut-down and indication on the panel with reset button
- Primary circulating shunt pump
- All controls are 24V
- Integral base frame

Additional options include:

- 7 day time clock
- Twin head primary pump
- Secondary shunt pump
- BMS interface signals
6.0 Connection and Ancillary Sizing

Secondary Connection Sizing – Cold Feed & Flow

Where a high water demand is required over a shorter period the correct sizing of the secondary cold feed and flow connections should be factored in to ensure the peak demand in litres per second is met.

It is generally bad practice for the cold feed to be smaller than the secondary flow due to the potential for a vacuum to be created. If this is the case, an anti-vacuum valve should be supplied with the unit.

Secondary Return Circulation

The Secondary Return sizing should be factored in to allow an efficient flow rate at all points of the property but also be sized at a level that avoids excessive secondary recirculation as this can lead to increased heat loss.

The Secondary Return rate should not exceed the flow rate across the Plate Heat Exchanger.

Normally the Secondary Return is a pipe size below the Hot Draw Off.

Primary Connections (PHE Pipework)

The size of the primary pipework is determined by the flow rate and connection sizes of the Plate Heat Exchanger. Plate Heat Exchanger data sheets are provided for each unit. Below is a table listing data from Standard PHE’s selected to suit different Boiler capacity requirements.

<table>
<thead>
<tr>
<th>Capacity (kW)</th>
<th>Pressure Drop (kPa)</th>
<th>Peak Demand (litres per second)</th>
<th>Hourly Demand (litres per hour)</th>
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</thead>
<tbody>
<tr>
<td>50</td>
<td>3.3</td>
<td>0.217</td>
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<td>100</td>
<td>3.6</td>
<td>0.435</td>
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<td>150</td>
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<td>200</td>
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<tr>
<td>350</td>
<td>5.0</td>
<td>1.522</td>
<td>5479</td>
</tr>
</tbody>
</table>

Relief Valve Sizing

Both the Safety and P&T (Pressure & Temperature) must be sized to give a discharge rating at least equal to the total power input to the hot water storage system.
Expansion Vessel Sizing

For an Unvented PLATEflow, the Expansion Vessel is sized according to the capacity, cold inlet pressure and working pressure of the cylinder.

The following formula can be used to calculate the minimum Expansion Vessel capacity:

\[
\text{Expansion} = \frac{\text{System Capacity (Litres)} \times \text{Thermal Expansion of Water (0.0227)}}{1 - \left(\frac{\text{Max Incoming Pressure} + 1}{\text{Max Working Pressure} + 1}\right)}
\]

Where the System Capacity is 110% of the cylinder capacity.
7.0 Installation & Commissioning

7.1 Installation

Installation should be carried out in accordance with current local Building Regulations and Water Byelaws.

Handling

The PLATEflow should be handled with care in order to avoid any damage to valves, fittings or external pipework.

The PLATEflow must not be lifted by any fittings or external pipework, as this can result in loosening off connections and risking possible leaks.

Lifting Lugs are provided at the top of the calorifier for lifting and movement.

Storage

The PLATEflow should be mounted on level and prepared foundations.

Vertical PLATEflows can be floor mounted, provided the floor is strong enough to support the full weight of the unit.

Horizontal PLATEflows are supported by cradles, positioned clear of the drain connection.

Pipework

All pipework should be secured with external supports and not by the PLATEflow unit itself.

Pipework should also include suitable bends or flexible joints to allow for expansion.

Access

It is essential that suitable access to all PLATEflow controls (e.g. Thermostats, Immersion Heaters, Safety Valve, etc.) and inspection points (e.g. Manhole, Temperature Gauges, etc.) is possible for inspecting, servicing and maintaining the unit.

Wiring

All electrical wiring should be carried out by a qualified electrician.

Immersion Heater High-Limit stats are factory set and should not be altered under any circumstances other than instruction by McDonald Water Storage.

Cold Feed Components

All cold feed components (Pressure Reducing Valve, Check Valve, Safety Valve, etc.) are to be fitted in the correct order, as shown in the following schematics, anywhere on the cold mains supply.

Ensure that all cold feed components are installed with the flow direction pointing towards the unit, as shown in the following schematics.

The Pressure Reducing Valve and Check Valve do not require to be sited close to the unit. If more convenient they may be sited where the cold mains supply enters the premises.

Operation

The PLATEflow should be properly flushed through with clean water prior to operation.
Schematics

Below are example installation schematics for both a Vertical and Horizontal Unvented PLATEflow.

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVV</td>
<td>Anti-Vacuum Valve</td>
</tr>
<tr>
<td>CF</td>
<td>Cold Feed</td>
</tr>
<tr>
<td>CP</td>
<td>Charging Pump</td>
</tr>
<tr>
<td>Cr</td>
<td>Cradle</td>
</tr>
<tr>
<td>CT</td>
<td>Control Thermostat</td>
</tr>
<tr>
<td>CV</td>
<td>Check Valve</td>
</tr>
<tr>
<td>Dr</td>
<td>Drain</td>
</tr>
<tr>
<td>EV</td>
<td>Expansion Vessel</td>
</tr>
<tr>
<td>FLV</td>
<td>Flow Limiting Valve</td>
</tr>
<tr>
<td>HD</td>
<td>Hot Draw</td>
</tr>
<tr>
<td>HLT</td>
<td>High-Limit Thermostat</td>
</tr>
<tr>
<td>IH</td>
<td>Immersion Heater</td>
</tr>
<tr>
<td>PG</td>
<td>Pressure Gauge</td>
</tr>
<tr>
<td>PI</td>
<td>Primary Flow Inlet</td>
</tr>
<tr>
<td>PR</td>
<td>Primary Flow Return</td>
</tr>
<tr>
<td>PRV</td>
<td>Pressure Reducing Valve</td>
</tr>
<tr>
<td>PTRV</td>
<td>Pressure/Temperature Relief Valve</td>
</tr>
<tr>
<td>PP</td>
<td>Primary Pump</td>
</tr>
<tr>
<td>SV</td>
<td>Safety Valve</td>
</tr>
<tr>
<td>SR</td>
<td>Secondary Return</td>
</tr>
<tr>
<td>TG</td>
<td>Temperature Gauge</td>
</tr>
<tr>
<td>CV</td>
<td>Cradle</td>
</tr>
<tr>
<td>CP</td>
<td>Charging Pump</td>
</tr>
<tr>
<td>Cr</td>
<td>Cradle</td>
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<tr>
<td>EV</td>
<td>Expansion Vessel</td>
</tr>
<tr>
<td>FLV</td>
<td>Flow Limiting Valve</td>
</tr>
<tr>
<td>HLT</td>
<td>High-Limit Thermostat</td>
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<tr>
<td>IH</td>
<td>Immersion Heater</td>
</tr>
<tr>
<td>PG</td>
<td>Pressure Gauge</td>
</tr>
<tr>
<td>PI</td>
<td>Primary Flow Inlet</td>
</tr>
<tr>
<td>PR</td>
<td>Primary Flow Return</td>
</tr>
<tr>
<td>PRV</td>
<td>Pressure Reducing Valve</td>
</tr>
<tr>
<td>PTRV</td>
<td>Pressure/Temperature Relief Valve</td>
</tr>
<tr>
<td>PP</td>
<td>Primary Pump</td>
</tr>
<tr>
<td>SV</td>
<td>Safety Valve</td>
</tr>
<tr>
<td>SR</td>
<td>Secondary Return</td>
</tr>
<tr>
<td>TG</td>
<td>Temperature Gauge</td>
</tr>
</tbody>
</table>

Wiring Centre

Legend

11
7.2 Commissioning

**Filling**
Before following instructions, ensure that all fittings are in place and tightened.

i) Check the Drain valve is closed
ii) Open the furthest tap from the PLATEflow
iii) Open the valve on the cold water supply to fill the tank and allow entrapped air to escape. When water issues from the tap, allow the water to run for a few minutes to flush any dirt and extraneous material.
iv) Open successive hot taps to purge any remaining air from the system. When satisfied that the system is free of air, close the taps.
v) Check all connections for any leaks and rectify as necessary.

**Safety Valves**
i) Manually open, for a few seconds, the Pressure & Temperature Relief Valve, situated on the top of the PLATEflow. Check that the discharged water runs freely away through the discharge pipework.
ii) Repeat for the Safety Valve, fitted onto the Cold Water Supply

**Immersion Heaters**
i) Switch on the electrical supply to the immersion heater(s) and allow the PLATEflow to heat up.
ii) Check that the control thermostat operates correctly.
iii) Check that no water discharges from either the Safety Valve or the Pressure and Temperature Relief Valve during the heating cycle.

**Plate Heat Exchanger**
It is essential that the exchanger is not subjected to thermal or mechanical shock as this could lead to premature failure.

Before following instructions, ensure that all fittings are in place and tightened.

i) Fully vent pipework system and the Plate Heat Exchanger.
ii) Close isolation valves between pump & exchanger.
iii) Fully open vale fitted into return line from the exchanger.
iv) Start the Charging Pump (PLATEflow side first).
v) *Slowly* open closed valve fitted to inlet line of exchanger.
vi) Vent circuit again if necessary
vii) Repeat for the other circuit.

During Operation:

i) Check there are no leaks around fittings.
ii) Check that the Plate Heat Exchanger is not subject to vibrations or pressure pulses. If found, stop operation and rectify. Continuous pressure pulses will result in fatigue failure of the plates.
**Flow Limiting Valve**

The following instructions relate to the Flow Limiting Valve supplied as standard by McDonald Water Storage.

Before setting flow rate, ensure the Charging pump is working and the Flow Limiting Valve is fully open.

i) Adjust indicator to mark the flow rate required.
ii) Pull the ring to open the obturator, allowing water to flow through the meter.
iii) Whilst keeping the obturator open, adjust control stem to set required flow rate, as marked by the indicator.
iv) Once flow rate has balanced, release the ring to close the obturator.

### 8.0 Construction Features

#### Inspection Manhole

- Mild Steel Plate
- Copper Plate
- Neck
- Sealed Rubber Gasket

#### Ringstand

- Drain

#### Cradles

Horizontal Only

150mm

#### Legs

Drain
9.0 Accessories

Plate Heat Exchanger

The External Plate Heat Exchanger acts as the primary heat exchanger between the primary flow from the Boiler and the secondary flow from the buffer vessel. Insulation is included. Flow rates must be specified when ordering.

Packaged PHE

Part of the PLATEflow Plus, the Packaged PHE assembly includes 1 to 4 pumps, a Control Box, Safety Valve, 3-Port Mixing Control Valve and a PHE, which allows additional plates to be added/removed to suit the Boiler Load accordingly.

Pressure & Temperature Relief Valves

Pressure and Temperature Relief Valves are used on buffer vessels to control and protect the system from pressure and excessive temperatures. Protection is provided by a mechanical thermostat, which will cause the valve to discharge a sufficient amount of hot water to prevent the pressure and/or temperature from exceeding their predetermined values.

Safety Valve

A Safety Valve is designed to automatically discharge water from the secondary circuit when a set pressure is exceeded protecting the working pressure of the buffer vessel. The safety valve features a full lift feature that will allow for sufficient discharge capacity for the buffer vessel.

De-Stratification Pump

The operation of a PLATEflow eliminates the requirement. However if the unit is operating with Immersion Heaters, the water temperature at the bottom of the Buffer Vessel can become tepid under certain conditions. To avoid legionella bacteria from forming, the De-stratification Pump circulates hot water from the top of the vessel through to the bottom at set intervals to ensure the full capacity reaches a minimum temperature of 60°C throughout.
Control Thermostat

Placed into the buffer vessel through a ½” boss and pocket, the Control Thermostat acts as an independent control device where a thermostat probe gives a temperature reading that ensures the relevant heat source switches on in the event that the buffer vessel drops below a set temperature.

High Limit Thermostat

Placed into the buffer vessel through a ½” boss and pocket, the High-Limit Thermostat acts as an independent control device where a thermostat probe gives a temperature reading that ensures the relevant heat source switches off in the event that the buffer vessel overheats.

Pressure Reducing Valve

Installed as part of a cold water control pack. Pressure Reducing Valves are used to control the incoming water supply to the cylinders, protecting the cylinder against damaged caused by excessive pressure from the supply.

Check Valve

Installed as part of a Cold Water Control Pack, a Check Valve is a one way valve that allows water to flow in only one direction. The Check Valve is installed to prevent backflow of hot water to the cold mains supply.

Pressure Gauge

The 100mm Pressure Gauge provides a pressure reading from 0-7 Bar of working pressure in the top of the cylinder through a probe placed through a ½” boss.

Temperature Gauge

The 100mm Temperature Gauge provides a temperature reading from 0 – 120°C for the temperature at the top and bottom of the cylinder through a ½” boss.

Inspection Manhole

Manholes are supplied to allow for internal inspection of the cylinder without having to remove the entire unit. We also provide suitable Insulation Jackets.
**Immersion Heaters**

Immersion Heaters are designed to heat the water within a cylinder directly to the temperatures set by their built in control and high limit thermostats through an electric heating element. Screw-in and Bolted Flange types available. Various kW options available to meet requirements.

**Anti-Vacuum Valve**

Anti-Vacuum Valves are designed to prevent a vacuum forming within a cylinder where there is potential for the draw off rate to exceed the incoming flow rate. Under normal working conditions, the Anti-Vacuum Valve is held closed by the working pressure and when a vacuum condition exists the suction will open the valve and allow air to flow through, equalising the pressure within the cylinder.

**Expansion Vessels**

Potable Expansion Vessels are used to absorb the increase in pressure, caused by thermal expansion within a cylinder as it heats up. Flow through vessels are also available.

**Flow Limiting Valve**

Fitted to the secondary flow pipework, the valve regulates the water flow to the Plate Heat Exchanger from the Buffer Vessel. This ensures the secondary water is heated to the correct temperature as it passes through the PHE.

**Charging Pump**

Fitted to the secondary flow pipework, this pump circulates the water from the bottom of the buffer vessel, through the PHE and back into the top of the cylinder. Easily replaceable with 2 connecting Isolating Valves.
10.0 Quality Management & Standards

At McDonald Water Storage, our commitment to providing a consistent delivery of hot water cylinders to the highest quality and fit for purpose is ensured by following the quality management programme ISO 9001:2015.

10.1 BS853

Our cylinders are manufactured strictly in accordance with the requirements of BS 853, which ensure they meet all current Health and Safety Legislation.

Our cylinders are subject to a two stage testing process where shell material is initially air tested for leaks and subsequently placed on an hydraulic test at 1.5 times the maximum working pressure of the cylinder, with a minimum of 6 hours of testing our cylinder are tested 12 times longer than the BS 853 requirements for the highest reliability.

All cylinders are manufactured with full traceability of material and assembly with each material and item used in manufacturing our cylinders individually recorded alongside the date of manufacture. Each stage of assembly and the individual operator who completes each process is recorded to provide a full manufacturing record.

All work and input into a cylinder is checked at all stages from its design, costing, issuing and manufacture to ensure the highest product quality is provided. During manufacture a 3 stage inspection process is in place at assembly, testing and final inspection once insulated to ensure our cylinder accurately reflects your requirements.

10.2 Pressure Equipment Directive (2014/68/EU)

As of June 2015, PLATEflow vessels need to meet the mandatory requirements of the Pressure Equipment Directive 2014/68/EU (PED).

The majority of fluids used within our cylinders (i.e. water, steam etc.) are classified as Group 2 Fluids, and thus follow the rules below:

1. Where the maximum design pressure (Bar) multiplied by the cylinder volume (Litres) is less than 10,000, or the design pressure is less than 10 bar, the cylinder must comply with the SEP (Sound Engineering Practice) and not carry the CE mark.

2. Cylinders which fall outside the previous parameters must carry the CE mark.
The above graph (taken from Annex II Table 4 of the PED) demonstrates the previous rules for Vessels for Group 2 liquids. “Article 4, Paragraph 3” refers to design compliance with the SEP (Sound Engineering Practice).

11.0 Supply Chain Management

Under quality management programme ISO 9001:2015, all suppliers of materials for use with our commercial systems are subject to continuous assessment and a formal annual review to ensure the highest service is supplied. Monthly quality management meetings also review all quality issues in an effort to provide continuous improvement to maintain our quality position within the market.
12.0 Standard Cylinder Layout & Heights

12.1 PLATEflow Commercial

Commercial PLATEflows are most suitable for installations where the main heat source will be from a remote Boiler supply and the flow rate demand varies throughout the day. McDonald Water Storage use a wide range of Plate Heat Exchangers to provide cylinders, suitable for various peak flow rates and hot water demands.

Shown is the Standard Layout for a PLATEflow. Other Layouts are available as required.

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<thead>
<tr>
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<th>MCDPF 450</th>
<th>MCDPF 500</th>
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*28mm Primary and Secondary Conns up to 600 Litre, then 1 ½” as standard for 600L and above.

** Heights indicate standard centre heights from ground for each of the connections, bespoke heights available upon request.

*** CAD Sketches available from the website: [https://www.mcdonaldwaterstorage.com/hot-water-cylinders-cad-files](https://www.mcdonaldwaterstorage.com/hot-water-cylinders-cad-files)
12.2 Horizontal PLATEflow

Horizontal PLATEflows are ideal for installation spaces where height is limited. Stabilised on a set of cradles, many of the PLATEflow connections are based on the top of the cylinder to provide a reduced height.

Shown is the Standard Layout for a Horizontal PLATEflow. Other Layouts are available as required.

*** CAD Sketches available from the website: https://www.mcdonaldwaterstorage.com/hot-water-cylinders-cad-files

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*28mm Primary and Secondary Conns up to 600 Litre, then 1 ½” as standard for 600L and above.

** Heights indicate standard centre heights from ground for each of the connections, bespoke heights available upon request.
The HWA Charter Statement requires that all members adhere to the following:

- To supply fit for purpose products clearly and honestly described
- To supply products that meet or exceed appropriate standards and building and water regulations
- To provide pre and post technical support
- To provide clear and concise warranty details to customers