CA-HVAC
THERMAL SUPPLIES

Copper & Copper-Lined Steel Calorifiers

Bespoke Sizes 230 ~ 9000 Litre

STORAGE CALORIFIERS

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CA-HVAC Storage Calorifiers

Background Information

When domestic hot water is required in volume the CA-HVAC range of storage calorifiers offers an ideal solution Stored water is heated indirectly by a primary medium (via an internal U-tube battery). Alternatively electric immersion heaters offer a clean and efficient primary heat source.

Factors affecting the choice of storage calorifiers are:-

- **Cost** - Storage calorifiers are often the most economical water heating solution.
- **Low Primary Power Requirement**- The stored hot water meets high peak demands with relatively low primary power, keeping the primary supply capital cost lower than in instantaneous or semi-storage systems.
- **Economical Temperature Control** - Simple on/off temperature control is often all that is required.
- **Reliability** - Storage calorifiers are robust and uncomplicated, giving excellent reliability and availability.
- **Space** - An instantaneous water heater may be more compact than a storage calorifier, but requires a larger primary heat source, negating some of the space saving.
- **Heat Loss** - Correct insulation of the calorifier results in low heat loss. Compared to instantaneous heaters the low, steady primary heat requirement reduces inefficient boiler cycling. Primary pipe-work is smaller and loses less heat. Electrically heated storage calorifiers, using off-peak electricity, give savings in running costs.

Type of Building	Category	Storage Litres Person	Heat-Up Period (Hours)
Hotel	5*	45	2
	3*	35	2
School/College	Boarding	25	2
	Day	5	3
Student Residence		35	3
Houses/Flats		45	2
Factories/Offices		5	3
Hospital Wards	In-Patient	30	1

Table 1: Typical Hot Water Storage Requirements

Storage Volume and Recovery Time

Storage calorifier **volume** and **recovery time** determine output. "Recovery time" is the time the calorifier takes to heat up from cold under zero demand. Long recovery times require low primary power and vice versa.

The tube battery (or immersion heater) is mounted low down in the calorifier. The contents are heated almost uniformly by natural convection. During draw-off the calorifier design minimises mixing of incoming cold water with the hot water above. If draw-off is too high the hot water layer becomes exhausted and the water drawn will be too cool. It is important to select an adequate storage volume to meet anticipated demand.

The "CIBSE Guide" gives design curves for storage calorifiers for various duties with worked examples. Also, as a quick guide, the figures given in the table below will, in our experience, give good results. Any sizing table should be used with a "common sense" estimate of the likely demand pattern. For example a business hotel may have a sharper morning peak demand than a tourist hotel. Available space or boiler power may also limit choice.

Standards

- **CA-HVAC Commercial Standard** A CA-HVAC Commercial Standard calorifier is designed for minimum cost without loss of performance or reliability, based on many years' experience of calorifier design and construction.

- **BS853** For customers who require a calorifier constructed to an internationally recognised standard. CA-HVAC Building Supplies will produce calorifiers to BS853 if required, both BS853 Part 1 & BS853 Part 2. There is scope within BS853 for 3rd party verification of design and construction. This adds to cost and delivery time, but can be arranged if required.

- **BS5500** For very high working pressures CA-HVAC Building Supplies can design and build calorifiers to BS5500. However BS853 now includes higher pressures so it is not often necessary to resort to BS5500.

- **Other Standards** CA-HVAC Building Supplies will consider production of calorifiers to other standards. Please contact us with details.

All our buffer vessels comply fully with the European Pressure Equipment Directive 97/23/EC

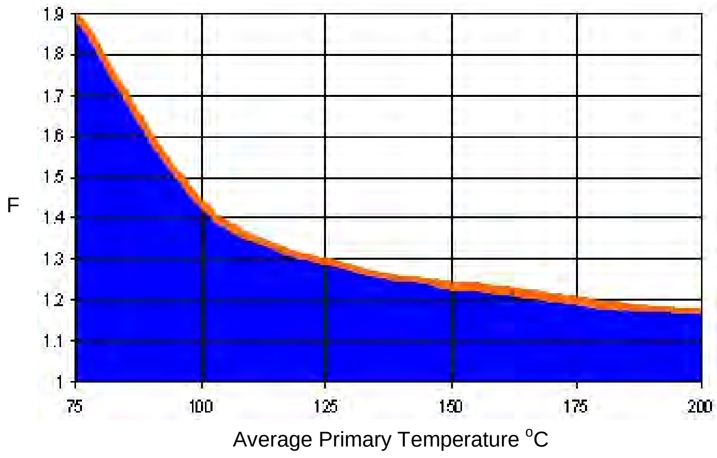
Primary Heat Source:
Steam, Water and other fluids.

- **Steam:** Steam condenses in a tube bundle and the latent heat transfers to the stored water. The resultant condensate is at the same temperature and pressure as the steam. This can cause noise in the condensate main, as steam "flashes" off the hot condensate after a steam trap. To cure this problem a **"flash bundle"** to condense the flash steam can be included in the calorifier if required.
- **Low Temperature Hot Water (LTHW):** Typically 82^{o}C flow / 71^{o}C return. A common source of primary heat.
- **Medium Temperature Hot Water (MTHW):** Maximum flow temperature 120^{o}C, maximum working pressure 10.0 BarG
- **High Temperature Hot Water (HTHW):** Flow temperature above 120^{o}C, maximum working pressure 17.5 BarG
- **Thermal Oils:** These allow high temperatures at low pressure. Primary connections should be flanged and have oil-resistant gaskets. Copper degrades some oils so the tube bundle may have cupro-nickel or stainless steel tubes.
- **Refrigerant:** Superheated refrigerant can be cooled (and condensed if required) to heat a calorifier between compressor and condenser. A back-up system should be provided for times when the calorifier is unavailable.
- **Waste Heat:** If waste heat is only available at low temperatures a separate top-up heat supply will be required. We can advise on the best match of calorifier to waste heat availability and hot water demand.

Calculating the primary power requirement - fluid primaries.

At the start of the heat up period, when the calorifier contents are cold, heat transfer is higher than at the end. To achieve design performance, primary power must match this. When the primary fluid is water or thermal oil, flowrate and flow temperature remain constant while return temperature starts low then rises during heat-up. For steam, temperature remains constant but flowrate starts high then decreases during heat-up.

Fig 1. Peak Power Correction Factor (F)



Calculating Average Primary Power:

Assuming a well insulated calorifier and ignoring any heat losses from primary pipe-work,
Average Primary Power Required,

$$Q = \frac{V \times 4.18 \times (T1-T2)}{t \times 3600} \text{ kW}$$

where: V = Storage Volume (litres)
t = Recovery Time (hours)
T1 = Required Temperature (usually 65^{o}C)
T2 = Cold Feed Temperature (usually taken as 10^{o}C)

Example: Calculate average primary power for a 2000L storage calorifier, with a 2 hour recovery time, heating water from 10^{o}C to 65^{o}C ?

Average Power Required

$$Q = \frac{2000 \times 4.18 \times (65-10)}{2 \times 3600} = \underline{64 \text{ W}}$$

Calculating Peak Primary Power:

Multiply Q by the correction factor F obtained from the chart below.

E.G. for LTHW primary:

82^{o}C Flow / 71^{o}C Return,
Secondary cold feed 10^{o}C, Flow 65^{o}C.
Average primary temperature = (82 + 71)/2 = 76.5^{o}C
From the chart, F = 1.8
From the example above, average power Q = 64 kW,
Peak Primary Power Required = 64 x 1.8 = 115 kW

E.G. for Steam primary:

Steam at 3 BarG (143.75^{o}C) after control valve, Secondary cold feed 10^{o}C, Flow 65^{o}C.
Average primary temperature = 143.75^{o}C
From the chart, F = 1.25
From the example above, average power Q = 64 kW,
Peak Primary Power Required = 64 x 1.25= 80 kW

NOTE:
Standard U-Tube bundles are externally finned for high performance. If requested, or for steam primary fluid, or if told that the water is hard, plain U-tubes may be offered.

Space must be allowed for withdrawal of the tube bundle for inspection. If withdrawal distance is not known assume full length. We will be pleased to advise withdrawal distances for specific units.

Materials of Construction

- √ **Solid Copper - type CS.** Copper is virtually impervious to attack by aggressive water. In the few areas where water is known to attack copper the calorifier can be protected by a sacrificial aluminium anode. This leaves a protective coating on the copper and does not need replacing. The copper thickness required for a calorifier increases with pressure and diameter. Above a certain size copper lined steel is more economical.
- √ **Copper-Lined Steel - type CL.** Carbon steel lined internally with copper. None of the steel is in contact with the water. The steel gives great strength, the copper prevents corrosion. Special techniques have been developed to ensure a close fit of copper to steel, to allow thermal expansion and contraction of the lining and to test the lining. Fitted as standard with an **anti-vacuum valve** to prevent partial vacuum damaging the lining. Even so care should be taken during drain-down to ensure adequate venting of the calorifier. The cold feed must never be restricted during draw-off.
- √ **Galvanised Steel - type GS.** Hot dip galvanising deposits a zinc layer which provides excellent protection against corrosion if the water is hard. Galvanised calorifiers should not be used with copper pipe-work or soft water. The copper causes electrolytic action and releases particles of copper which deposit in the calorifier, causing localised electrolytic action and corrosion. Soft water prevents formation of a protective scale. The copper tube bundle rapidly gets a film of scale because of its higher temperature. This prevents electrolytic action and corrosion. For added protection a magnesium sacrificial anode can be fitted. This must be replaced when exhausted. Also the copper tube bundle can be electro-tinned which reduces the electrochemical potential.
- √ **Stainless Steel - type SS.** Stainless steel calorifiers can suffer chloride attack at welds. Most water supplies contain enough chloride to cause problems. Heat treatment after all welding is completed solves the problem but is expensive. If the water supply is chloride free (e.g. de-ionised water) then stainless steel calorifiers will be acceptable.
- √ **Glass/Polymer Lined Steel - type PL.** An alternative to copper-lined steel. The lining was developed for arduous conditions in industrial processes. It is generally more resistant to abrasion, chemical attack and impact damage than traditional glass linings. If damage occurs the surrounding coating will not be affected and the damage can be repaired. In the lining process minute glass flakes are combined with a special polymer, applied to the steel, cured and electrically tested. The lining is WRC approved for use with hot water.

Other materials available on request. Please contact our sales department with any enquiries you may have.

Some System Considerations

Secondary Vent. Calorifiers can be supplied for open vented or unvented (sealed) systems. In open vented systems the vent pipe allows escape of air from the calorifier, ingress of air during drain-down, thermal expansion of water and (in the event of control failure) escape of steam from the calorifier. The vent pipe should never be blocked. No valves should be fitted to it except, where more than one calorifier share a common vent, special 3-way vent/bypass valves. These ensure that the calorifier is always open to atmosphere.
Unvented systems. When it is not practical to fit a vent, an unvented system will be used. Certain additional precautions and equipment are necessary to ensure that an unvented system will be safe:

- √ The calorifier must be designed for the maximum working pressure - after thermal expansion of the water.
- √ A Temperature (or combined Pressure/Temperature) Relief Valve must be fitted in case of control failure.
- √ An automatic air vent.
- √ An anti-vacuum valve
- √ An expansion vessel.

A water booster set may be required to provide water at the required pressure and flowrates.
Secondary Return. Most large systems circulate DHW around a building and back to the calorifier. This ensures that all draw-off points have hot water available quickly. The pipe-work should be lagged and the re-circulation rate minimised to reduce heat loss. The heat loss should be taken into account when selecting a calorifier.

Thermal Insulation Options

- √ **Type MA** Consists of 50mm mineral wool with dimpled aluminium cladding. This gives good thermal insulation and a quality finish. For some installations there will be a high risk of damage to the factory fitted insulation. In these instances it is preferable to insulate on site.
- √ **Type UF** For sizes up to 1000 litres or 250 kg dry weight (approximately) we can offer **Type UF** semi-rigid urethane foam insulation. This is sprayed on in a standard thickness of 25mm (up to 60mm on request). Its ozone depletion potential (ODP) is zero, it does not support combustion and it resists water penetration. Uniform thickness is not guaranteed.

For a high quality appearance we recommend type MA insulation.

Materials

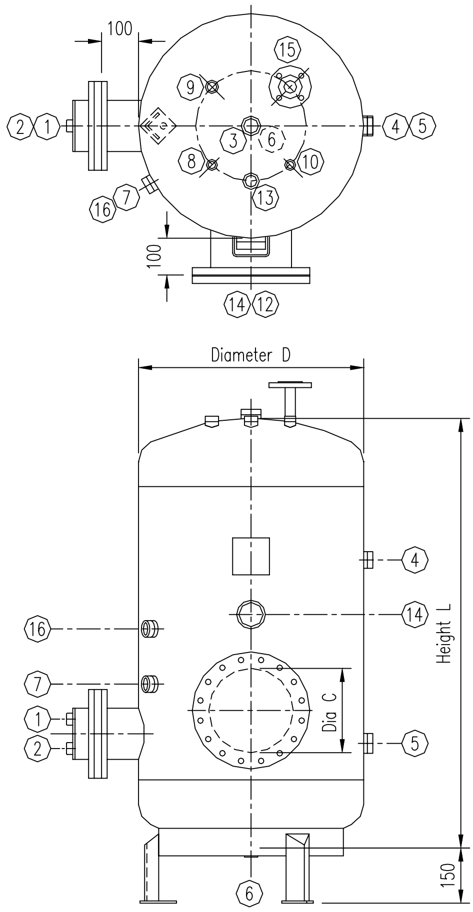
Type	**CS**	**CL**	**GS**	**SS**	**PL**
Shell	Copper	Copper-Lined	Galvanised Steel ***2**	Stainless Steel	Glass-Lined
Battery Tubes	Copper (Finned or Plain)	Copper (Finned or Plain)	Copper (Finned or Plain, Tinned)	Stainless or Copper (Finned or Plain)	Stainless or Copper (Finned or Plain)
Tubeplate	Brass	Brass	Galvanised Steel	Stainless or Brass	Stainless or Brass
Primary Header	Mild Steel	Mild Steel	Mild Steel	Mild Steel or Stainless Steel	Mild Steel or Stainless Steel
Insulation	50mm Mineral Wool Slabs & 0.9mm Stucco Aluminium Casing				

WATER HEATING MADE EASY

Notes:
*1 - Immersion Heater option (14) is for back-up of primary (steam, water etc) heat source.

*2 - Galvanised calorifiers are not suitable for use with soft or acidic water and is not to be used in conjunction with copper pipework

*3 - Connections in [cyan] boxes are flanged, otherwise connections are screwed

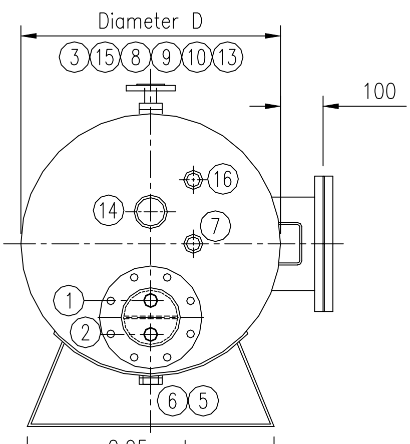


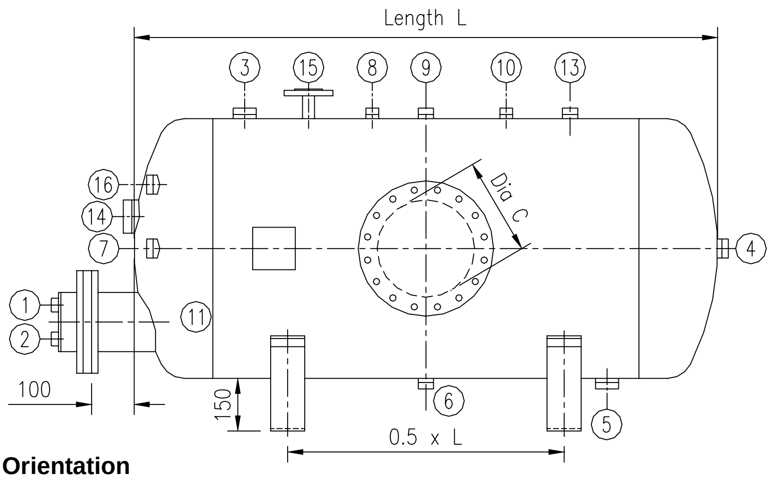
Vertical Orientation

Connections

Ref	Description	Size	Ref	Description	Size
1	Primary Inlet	Varies	9	Safety Valve	Varies
2	Primary Outlet	Varies	10	Pressure Gauge	⅜”
3	Secondary Flow	Varies	11	Vent (Optional)	Varies
4	Secondary Return	Varies	12	Pressure Gauge (Steam Only)	⅜”
5	Cold Feed	Varies	13	Anti-Vacuum Valve (Optional)	Varies
6	Drain	Varies	14	Immersion Heater (Optional) *1	Varies
7	Control Thermostat	1”	15	Bursting Disc (If Specified)	Varies
8	Thermometer	¾”	16	High Limit Thermostat (Optional)	1”

Size Litres	D (mm)	L (mm)	C (mm)	Main Connection Sizes					
				3	4	5	6	11	13
230	508	1270	200	1¼”	1”	1¼”	¾”	1”	¾”
270	508	1473	200	1¼”	1”	1¼”	¾”	1”	¾”
360	610	1372	200	1¼”	1”	1¼”	¾”	1”	¾”
450	610	1753	200	1½”	1”	1½”	¾”	1”	¾”
500	686	1473	250	1½”	1”	1½”	¾”	1”	¾”
550	686	1727	250	1½”	1”	1½”	¾”	1”	¾”
600	762	1448	300	1½”	1”	1½”	¾”	1”	¾”
700	762	1678	300	1½”	1”	1½”	¾”	1”	¾”
800	762	1930	300	1½”	1”	1½”	¾”	1”	¾”
900	813	1956	300	1½”	1½”	1½”	¾”	1¼”	¾”
1000	915	1753	300	2”	1½”	2”	1”	1¼”	1”
1200	915	2086	300	2”	1½”	2”	1”	1¼”	1”
1500	1067	1956	375	2”	1½”	2”	1”	1¼”	1”
1750	1067	2175	375	2”	1½”	2”	1”	1¼”	1”
2000	1067	2388	375	2”	1½”	2”	1”	1½”	1”
2250	1220	2133	450	65	2”	65	1”	1½”	1¼”
2500	1220	2388	450	65	2”	65	1”	1½”	1¼”
3000	1220	2845	450	80	2”	80	1”	1½”	1½”
3500	1372	2743	450	80	2”	80	1”	1½”	1½”
4000	1372	3081	450	80	2”	80	1”	1½”	1½”
4500	1524	2768	450	80	2”	80	1”	1½”	1½”
5000	1524	3048	450	80	2”	80	1”	2”	1½”
5500	1524	3302	450	100	65	100	1”	2”	2”
6000	1600	3429	450	100	65	100	1”	65	2”
7000	1676	3302	450	100	65	100	1”	65	2”
8000	1676	3657	450	125	65	125	1½”	65	2x2”
9000	1676	3911	450	125	65	125	1½”	65	2x2”





Horizontal Orientation