

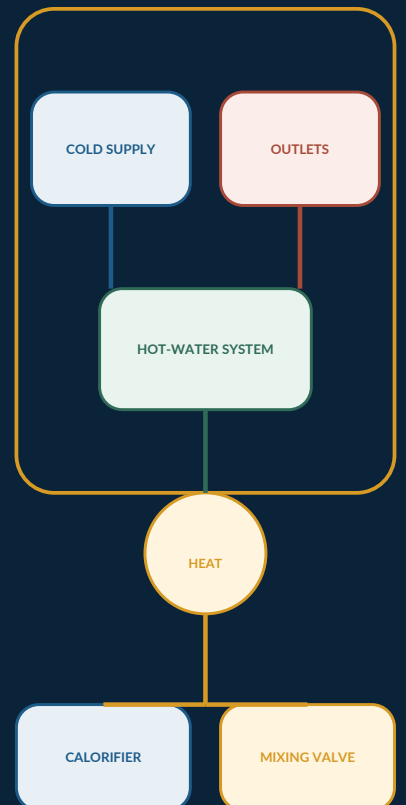
# Understanding Hot-Water Systems

An owner's guide to calorifiers,  
heating sources, pressure and scald protection

Hot water combines heat, pressure and stored energy.  
A small control or relief fault can cause leakage,  
scalding, electrical damage or coolant loss.  
Safe operation depends on the complete installation.

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GUIDE OVERVIEW

# What marine hot-water systems are designed to do

A yacht hot-water system heats and stores potable water, controls expansion and pressure, tempers delivery temperature and distributes water safely to showers, sinks and appliances.

|       |                                                                                                                                                                                                                                                                   |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SCOPE | This guide covers calorifiers and water heaters using electric elements, engine coolant, hydronic boilers or dedicated fuel-fired heat. Potable-water hygiene, pressure-vessel, engine-coolant and electrical requirements vary by installation and jurisdiction. |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

By the end of this guide, you should be able to:

- Trace cold water through the heater, mixing valve and hot-water distribution.
- Identify heating elements, coolant coils, thermostats, relief valves, expansion vessels and recirculation pumps.
- Recognise scald risk, pressure faults, element failure, coolant interaction and hidden leakage.
- Understand how hot-water demand affects electrical, freshwater and heating-system capacity.
- Ask better questions during purchase, survey, maintenance and offshore preparation.

|                |                                                                                                                                                                |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CORE PRINCIPLE | A hot-water system must control temperature, pressure and cross-connection. Heating water safely is more important than achieving the hottest possible outlet. |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|

## Safety

Stored hot water can cause severe scalding and remains pressurised after electrical power is isolated. Heating elements may remain live from shore, generator or inverter, and engine-coolant coils can connect the domestic system to critical machinery cooling. Allow cooling and isolate every source before work.

SYSTEM ARCHITECTURE

# From the cold-water supply to safe hot-water delivery

A complete system includes a pressurised cold-water source, storage vessel, heat input, thermostat, expansion control, pressure relief, temperature mixing and insulated distribution.



| Layer                          | Purpose                                                                           | Owner focus                                                                                |
|--------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| Cold-water inlet               | Supplies potable water and may include non-return or pressure-reducing equipment. | Know isolation, pump pressure and whether thermal expansion can return to the cold system. |
| Heat source                    | Transfers energy through an element or heat-exchanger coil.                       | Identify every active source and independent isolation.                                    |
| Storage vessel                 | Stores heated water under pressure.                                               | Age, material, insulation, mounting, leaks, corrosion and anode where applicable.          |
| Temperature control            | Stops heat input at the intended storage temperature.                             | Thermostat accuracy, high-limit cut-out and sensor condition.                              |
| Pressure and expansion control | Allows heated-water expansion and relieves unsafe pressure.                       | Expansion vessel, relief-valve discharge and no blocked outlet.                            |
| Mixing and distribution        | Reduces outlet temperature and carries water to fixtures.                         | Mixing-valve function, pipe insulation, recirculation and dead legs.                       |

MORE HEAT CREATES MORE EXPANSION

A calorifier heated by engine coolant may reach a different temperature from one heated electrically. Pressure and mixing arrangements must cope with the hottest credible source.

MAIN COMPONENTS

# What owners should be able to identify

The installation should be traceable from freshwater pump to heater, heating sources, relief discharge, mixing valve, recirculation loop and every isolation point.

CALORIFIER

Insulated pressure vessel with internal heat source

ELEMENT / COIL

Electrical or engine / boiler heat input

PRESSURE CONTROL

Expansion vessel, relief and non-return arrangement

MIXING / OUTLETS

Tempered distribution to showers and sinks

Owners should know which heating source is active alongside, underway and during generator or engine shutdown.

| Component or area                 | Why it matters                                            | Owner focus                                                                                  |
|-----------------------------------|-----------------------------------------------------------|----------------------------------------------------------------------------------------------|
| Calorifier or heater vessel       | Stores hot potable water under pressure.                  | Capacity, material, insulation, mounting, corrosion, seams and service access.               |
| Electric heating element          | Uses shore, generator or inverter AC to heat water.       | Power rating, breaker, thermostat, earth protection and scale.                               |
| Engine-coolant coil               | Uses waste heat from the propulsion engine.               | Isolation valves, hose condition, coolant compatibility and effect of internal coil failure. |
| Boiler or hydronic coil           | Uses the yacht heating loop as a heat source.             | Pump or valve control, temperature, fluid compatibility and summer operation.                |
| Thermostat and high-limit         | Controls normal temperature and stops unsafe overheating. | Set point, reset, sensor and evidence of repeated trips.                                     |
| Mixing valve and relief equipment | Controls outlet temperature and system pressure.          | Correct orientation, adjustment, discharge route and periodic function.                      |

RELIEF DISCHARGE  
MUST BE VISIBLE AND  
SAFE

A pipe that terminates unseen in a bilge can hide repeated overpressure, contaminate the bilge and delay diagnosis.

HEATING SOURCES

# Electric elements, engine coolant and hydronic heat

Multiple heat sources improve convenience but can create interaction, backflow and overtemperature risks if isolation and control are unclear.

**ELECTRIC ELEMENT**

Simple controlled heat using shore or generator power

**ENGINE COOLANT**

Uses propulsion waste heat while underway

**HYDRONIC BOILER**

Uses cabin-heating loop or dedicated circuit

**FUEL-FIRED HEATER**

Independent heat but adds combustion and exhaust risks

The storage vessel can receive heat after the electrical switch is off if engine or hydronic circulation remains active.

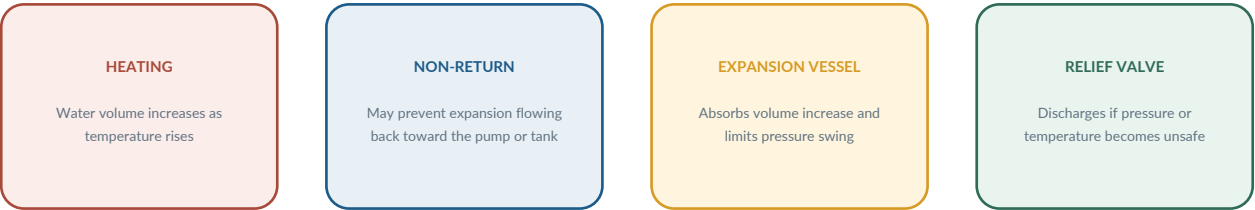
| Area                              | What matters                                                | Owner focus                                                               |
|-----------------------------------|-------------------------------------------------------------|---------------------------------------------------------------------------|
| Electric element                  | Predictable heating with thermostat control.                | Electrical load, scale, dry-firing risk and high-limit operation.         |
| Engine-coolant coil               | Efficient underway and no separate electrical load.         | Engine temperature, hose routing, coolant loss and unwanted thermosiphon. |
| Hydronic-heating coil             | Integrates hot water with cabin heating.                    | Summer mode, circulation, antifreeze and cross-system isolation.          |
| Dedicated fuel-fired water heater | Can supply water without running engine or large generator. | Fuel, combustion air, exhaust, flame protection and serviceability.       |
| Solar or alternative heat         | May supplement hot-water production.                        | Overtemperature, control, freeze protection and plumbing complexity.      |
| Dual-source operation             | Can heat more quickly or maintain temperature.              | Ensure control settings and vessel pressure limits remain compatible.     |

|                                         |                                                                                                                                           |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| HEAT SOURCES NEED INDEPENDENT ISOLATION | A leaking calorifier or failed coil may require the domestic, engine or hydronic side to be isolated without disabling unrelated systems. |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|

PRESSURE AND EXPANSION

# Stored energy, relief valves and expansion vessels

Water expands when heated. In a closed system this raises pressure unless expansion can return through the cold supply or be absorbed by a dedicated vessel.



The relief valve is a final safeguard, not a normal method of controlling routine thermal expansion.

| Area                        | What matters                                                   | Owner focus                                                               |
|-----------------------------|----------------------------------------------------------------|---------------------------------------------------------------------------|
| Non-return valve            | Prevents hot water or pressure returning into the cold supply. | Its presence may make a dedicated expansion vessel essential.             |
| Expansion vessel            | Provides compressible volume as water heats.                   | Pre-charge, diaphragm, isolation, sizing and hot-to-cold pressure change. |
| Pressure-relief valve       | Protects vessel and pipework from excessive pressure.          | Rating, corrosion, leakage, discharge route and replacement interval.     |
| Temperature-pressure relief | Some systems combine pressure and overtemperature protection.  | Correct probe location and unobstructed discharge.                        |
| Freshwater pump pressure    | Sets the cold static pressure entering the heater.             | Cut-in and cut-out settings must suit the vessel and relief equipment.    |
| Pressure-reducing valve     | Limits shore or dock-water pressure where connected.           | Do not assume marina pressure matches the yacht's design.                 |

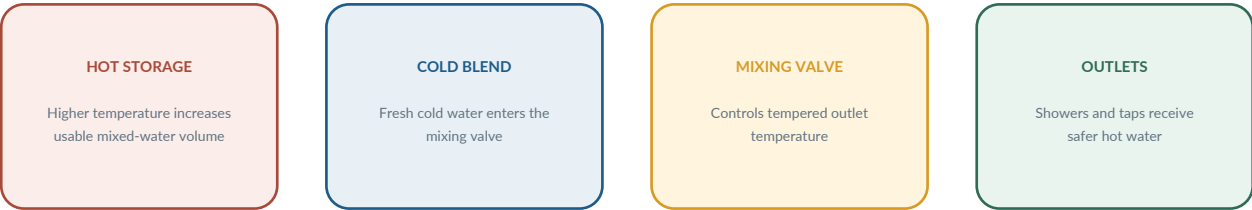
A DRIPPING RELIEF VALVE IS EVIDENCE

It may indicate normal expansion without a vessel, high pump pressure, a failed expansion vessel, scale or overheating. Do not simply cap or reroute it.

TEMPERATURE AND SCALD CONTROL

# Storage temperature, mixing valves and safe outlets

The stored water may be hotter than a safe shower temperature, especially after long engine runs. A thermostatic mixing valve blends cold water before distribution.



A failed or fouled mixing valve can produce unexpectedly hot or cold water even when the calorifier is healthy.

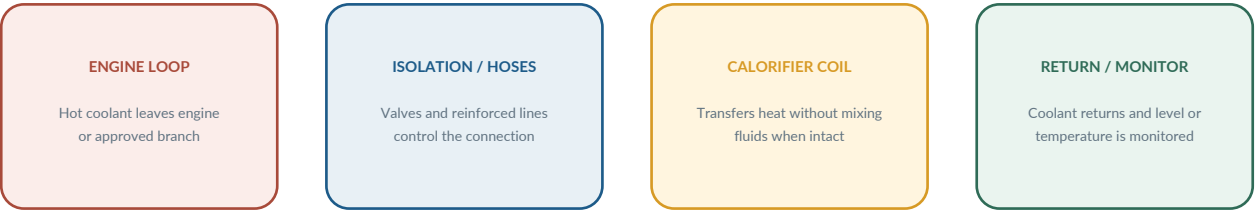
| Area                              | What matters                                              | Owner focus                                                                     |
|-----------------------------------|-----------------------------------------------------------|---------------------------------------------------------------------------------|
| Storage thermostat                | Controls electric or fuel-fired heat input.               | Set for manufacturer and hygiene requirements without excessive scald risk.     |
| Engine-heated temperature         | May exceed electric thermostat setting.                   | Assess maximum engine-coolant conditions and mixing-valve capacity.             |
| Thermostatic mixing valve         | Blends hot and cold supply to a controlled outlet.        | Scale, debris, orientation, adjustment and response to loss of cold water.      |
| Point-of-use mixing               | Local shower or tap controls final temperature.           | Cannot always protect all outlets or prevent hot distribution pipework.         |
| Pipe insulation                   | Reduces heat loss and protects adjacent materials.        | Maintain access and avoid hiding leaks or hot surfaces.                         |
| Legionella and hygiene management | Storage and usage pattern influence microbiological risk. | Follow vessel-specific water-hygiene guidance and avoid casual unsafe settings. |

|                                 |                                                                                                                                          |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| <b>TEST AFTER AN ENGINE RUN</b> | A mixing valve that appears correct on electric heat may not control the higher stored temperature reached after several hours underway. |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|

ENGINE-COOLANT INTEGRATION

# Protecting propulsion cooling from domestic-system faults

An internal calorifier coil transfers engine heat but also creates a connection between a domestic vessel and the engine-cooling circuit. Hose or coil failure can affect critical coolant inventory.



An internal coil failure can allow cross-contamination in either direction depending on relative pressure.

| Area                                 | What matters                                                                   | Owner focus                                                                    |
|--------------------------------------|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| Coolant branch connection            | Must preserve engine flow and temperature control.                             | Use approved points and avoid restricting the main cooling circuit.            |
| Isolation valves                     | Allow the calorifier branch to be removed after a leak.                        | Clearly label normal position and confirm engine-safe operation when isolated. |
| Hoses and clamps                     | Carry hot coolant through accommodation or machinery spaces.                   | Heat rating, chafe, support, double clamps where appropriate and access.       |
| Internal coil                        | Separates coolant from potable water while transferring heat.                  | Age, material, leakage evidence and replacement practicality.                  |
| Thermosiphon or unwanted circulation | Can continue heating or alter engine warm-up when pumps are stopped.           | Check valves, routing and temperature behaviour.                               |
| Coolant inventory                    | A calorifier leak can drain more coolant than the engine header tank suggests. | Monitor level and have a clear emergency isolation procedure.                  |

|                                                   |                                                                                                            |
|---------------------------------------------------|------------------------------------------------------------------------------------------------------------|
| DOMESTIC HOT WATER SHOULD NOT THREATEN PROPULSION | A failed calorifier hose or coil should be isolatable without leaving the engine unable to operate safely. |
|---------------------------------------------------|------------------------------------------------------------------------------------------------------------|

DEPENDENCIES AND RESILIENCE

# What can remove hot water or create wider system effects

Hot water depends on freshwater pressure, one or more heat sources, thermostats, valves and distribution. Failure may also affect engines, generators, hydronic heating or electrical load.

**FRESHWATER PUMP**  
No pressure means no useful hot-water delivery

**SHARED ELECTRICAL**  
Element depends on generator, shore or inverter

**SHARED COOLANT**  
Engine or boiler loop creates cross-system consequence

**SHARED VESSEL**  
One leak or relief fault can remove stored water

Alternative heating is valuable only if the calorifier, pressure and distribution system remain intact.

| Area                              | What matters                                                        | Owner focus                                                          |
|-----------------------------------|---------------------------------------------------------------------|----------------------------------------------------------------------|
| Freshwater supply                 | Pump, accumulator or tank fault removes both hot and cold services. | Know manual or backup water options and isolation.                   |
| Electrical source                 | Element may be one of the larger domestic loads.                    | Generator reserve, breaker, inverter capability and load shedding.   |
| Engine or hydronic source         | Hot water depends on propulsion or cabin-heating operation.         | Plan for periods at anchor or after machinery isolation.             |
| Single storage vessel             | Tank corrosion or relief fault removes all hot-water capacity.      | Assess age, access and possibility of bypass or replacement.         |
| Mixing valve                      | One failure can affect every outlet.                                | Keep suitable service access and understand temporary safe settings. |
| Watermaker and freshwater reserve | Hot-water usage increases total water demand.                       | Include showers and cleaning in passage water planning.              |

**HOT-WATER LOSS IS USUALLY MANAGEABLE; LEAKAGE MAY NOT BE**

The priority after a calorifier or pipe failure is to control water, pressure, electricity and coolant before restoring comfort.

MONITORING AND FAILURE AWARENESS

# Common warning signs and what they may indicate

Hot-water faults often begin with slow heating, temperature instability, relief-valve drips, pump cycling, rusty water, coolant loss or damp insulation around the vessel.

**NO / LOW HEAT**  
Element, thermostat, source or heat-transfer fault

**OVERHEAT / SCALD**  
Thermostat, mixing valve or engine heat problem

**PRESSURE / LEAK**  
Expansion, relief, vessel or pipe fault

**CROSS-SYSTEM**  
Coolant coil or connection problem

A relief valve, mixing valve or coolant branch can fail gradually before the loss becomes obvious.

| Observation                        | What it may indicate                                                          | Owner response                                               |
|------------------------------------|-------------------------------------------------------------------------------|--------------------------------------------------------------|
| Water heats slowly or not at all   | Failed element, thermostat, breaker, scaled vessel or no coolant circulation. | Identify active heat source before replacing components.     |
| Water becomes dangerously hot      | Thermostat, high-limit or mixing-valve failure, or hotter engine source.      | Stop heat input and prevent use until controlled.            |
| Relief valve drips during heating  | Thermal expansion, failed vessel, high pump pressure, scale or overheating.   | Investigate rather than plugging the discharge.              |
| Freshwater pump cycles with no use | Hot-water leak, relief discharge, non-return or accumulator issue.            | Locate water loss and protect electrical or interior spaces. |
| Engine coolant level falls         | Calorifier hose, coil or branch connection leak.                              | Isolate the branch if designed and protect the engine.       |
| Discoloured or odorous hot water   | Tank corrosion, stagnant branch, anode or hygiene issue.                      | Inspect vessel condition and follow potable-water guidance.  |

COMPARE HOT AND COLD SIDES

If only hot water is affected, focus on heater, mixing and distribution. If both are affected, the freshwater pump or supply may be the common cause.

## FAILURE RESPONSE

# Controlling leaks, heat, electricity and coolant

The safe response is to identify every heat source, isolate the domestic vessel, control water leakage and confirm whether engine or hydronic coolant is involved.

**RECOGNISE**

Leak, scald, no heat,  
relief flow or coolant loss

**ISOLATE HEAT**

Switch element and stop or  
isolate other heat sources

**ISOLATE WATER**

Close cold feed and relieve  
pressure safely

**PROTECT MACHINERY**

Check engine or boiler coolant  
and isolate coil branch

**CONTROL / REPAIR**

Contain water and arrange  
safe restoration

| Situation or stage               | Immediate thinking                                                                    | Avoid                                                                 |
|----------------------------------|---------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| Scalding outlet temperature      | Stop heat input, warn crew and isolate or bypass only under approved safe procedure.  | Continuing use because a tap mixer appears controllable.              |
| Calorifier or pipe leak          | Isolate cold feed and electrical element, contain water and protect nearby equipment. | Leaving a heating element energised in an empty vessel.               |
| Relief valve flowing heavily     | Stop heat and freshwater pump or shore supply; allow cooling.                         | Capping or clamping the relief line.                                  |
| Engine coolant loss              | Check branch and isolate the calorifier coil if the engine design allows.             | Continuing propulsion without confirming safe coolant level and flow. |
| Electrical trip or burning smell | Isolate the heater circuit and inspect for water or connection damage.                | Resetting a wet or overheated element circuit.                        |
| No hot water offshore            | Use cold water, reduce comfort demand and preserve freshwater.                        | Improvised open-flame or unapproved immersion heating.                |

**NEVER ENERGISE A DRY ELEMENT**

An electric immersion element can overheat and fail quickly if the calorifier has been drained or airlocked.

## TESTING AND DEMONSTRATION

# Testing heat sources, pressure protection and safe delivery

A meaningful test should operate each heat source separately, observe warm-up and pressure behaviour, verify mixing and demonstrate relief and high-limit functions by approved methods.



| Test                               | What it demonstrates                                               | Limitations / owner focus                                                      |
|------------------------------------|--------------------------------------------------------------------|--------------------------------------------------------------------------------|
| Electric-element test              | Shows breaker, thermostat, element and warm-up performance.        | Confirm vessel is full and generator or shore capacity is adequate.            |
| Engine-heat test                   | Shows coolant circulation and maximum stored temperature underway. | Monitor engine temperature and coolant level.                                  |
| Hydronic-source test               | Shows boiler valve, pump and coil heat transfer.                   | Confirm summer mode and no unwanted cabin heating.                             |
| Pressure trend test                | Shows expansion-vessel behaviour from cold to hot.                 | Use suitable gauge and do not exceed vessel limits.                            |
| Mixing-valve test                  | Shows tempered temperature at near and remote outlets.             | Repeat after the hottest credible storage condition.                           |
| Relief and high-limit verification | Confirms final protective functions by approved procedure.         | Use competent service; do not create uncontrolled overpressure or overheating. |

## TEST EACH SOURCE SEPARATELY

A vessel that becomes hot after an engine run does not prove the electric element or hydronic source works, and vice versa.

MAINTENANCE STRATEGY

# Keeping the vessel, controls and distribution dependable

Maintenance should preserve vessel integrity, clean heat-transfer surfaces, safe electrical connections, sound coolant hoses, correct expansion, working relief and accurate temperature control.

| Area                            | Good maintenance evidence                                                            | Why it matters                                           |
|---------------------------------|--------------------------------------------------------------------------------------|----------------------------------------------------------|
| Calorifier vessel               | Dry exterior, sound seams and mounts, insulation and internal anode where specified. | Controls leakage, corrosion and structural movement.     |
| Electric element and thermostat | Current, terminals, earth protection, scale, thermostat and high-limit service.      | Maintains safe and efficient electrical heating.         |
| Coolant or hydronic coil        | Hoses, clamps, isolation, fluid compatibility and leak history.                      | Protects engines and heating systems from cross-failure. |
| Expansion and relief            | Vessel pre-charge, relief condition, visible discharge and no persistent leakage.    | Controls pressure safely.                                |
| Mixing valve                    | Clean strainers, stable outlet temperature and accessible adjustment.                | Prevents scalding and temperature instability.           |
| Distribution                    | Pipe support, insulation, joints, recirculation pump and dead-leg review.            | Limits water damage, heat loss and hygiene issues.       |

## Owner-level routine

- Inspect the vessel, relief discharge and surrounding insulation for moisture.
- Check hot outlet temperature after electric heating and after a long engine run.
- Investigate freshwater-pump cycling or coolant loss promptly.
- Exercise heater and branch isolation valves and keep labels current.
- Review hot-water electrical load and water consumption during passage planning.

|               |                                                                                                                                                                                   |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| WORK TO REFER | Pressure-vessel repair, element or mains wiring, relief-valve selection, coolant-coil diagnosis and potable-water hygiene treatment should be completed by competent specialists. |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## BUYER AND SURVEY PERSPECTIVE

# Assessing safety, vessel condition and cross-system risk

A buyer should see each heat source operate, inspect pressure and relief behaviour, test safe outlet temperature and understand how a calorifier failure could affect freshwater or engine cooling.

| Area                        | Questions or evidence                                                                  |
|-----------------------------|----------------------------------------------------------------------------------------|
| Vessel condition            | What is the calorifier age, material, access, corrosion, leakage and replacement path? |
| Heat sources                | Do electric, engine and hydronic inputs each work and isolate independently?           |
| Pressure control            | Are non-return, expansion vessel, relief valve and pump pressure compatible?           |
| Temperature control         | Do thermostat, high-limit and mixing valve prevent overheating and scalding?           |
| Engine interaction          | Can the coolant branch be isolated safely and is cross-leak history absent?            |
| Distribution                | Are hidden joints, recirculation, insulation and remote outlets sound?                 |
| Electrical and water demand | Can the yacht support element load and intended shower or cleaning use offshore?       |

## Evidence worth requesting

- Calorifier, element and relief-valve service history.
- Electric, engine and hydronic heat-source demonstration.
- Cold-to-hot pressure and mixed outlet-temperature readings.
- Engine-coolant branch and isolation information.
- History of relief discharge, leaks, rusty water or pump cycling.

### A DRY EXTERIOR IS NOT THE ONLY EVIDENCE

Internal coil failure, scale, expansion problems or a seized mixing valve may exist without visible leakage from the calorifier shell.

## OFFSHORE READINESS

# Questions before relying on hot water offshore

A ready system heats water from the intended sources, controls pressure and scald risk, remains isolatable after a leak and does not threaten engine cooling or electrical safety.

| Area                      | Question to resolve                                                             |
|---------------------------|---------------------------------------------------------------------------------|
| Heat sources              | Which source operates alongside, underway and during generator or engine loss?  |
| Pressure                  | How is thermal expansion absorbed and where does relief discharge go?           |
| Temperature               | What is the hottest stored condition and how is delivery tempered?              |
| Machinery interaction     | Can an engine or hydronic coil be isolated without compromising safe operation? |
| Leak response             | Can the vessel, cold feed and every heat source be isolated quickly?            |
| Water and energy planning | How much freshwater and electrical or fuel capacity does normal use require?    |

## Quick readiness check

|                          | Readiness statement                                                                          |
|--------------------------|----------------------------------------------------------------------------------------------|
| <input type="checkbox"/> | I can identify the vessel, every heat source, relief, expansion, mixing and isolation point. |
| <input type="checkbox"/> | Electric, engine and hydronic heating have been demonstrated separately where fitted.        |
| <input type="checkbox"/> | Cold-to-hot pressure behaviour and relief discharge are understood.                          |
| <input type="checkbox"/> | Safe outlet temperature has been checked after the hottest credible storage condition.       |
| <input type="checkbox"/> | There are no unresolved leaks, relief drips, scalding, coolant loss or pump cycling.         |
| <input type="checkbox"/> | The engine or hydronic coil can be isolated using a documented procedure.                    |
| <input type="checkbox"/> | Crew know how to isolate heat, water and electricity after a leak.                           |
| <input type="checkbox"/> | Current diagrams, baseline readings, selected spares and specialist contacts are available.  |

### KEY TAKEAWAY

Dependable hot water combines a sound pressure vessel, controlled heat sources, effective expansion and relief, safe temperature mixing, protected machinery connections and quick isolation after failure.

## Guidance to consult

Use current vessel freshwater, electrical, engine-cooling and hydronic drawings and the installed calorifier, element, thermostat, relief and mixing-valve manufacturers' instructions, together with applicable potable-water, pressure, flag-state, coding, insurer and service requirements.

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