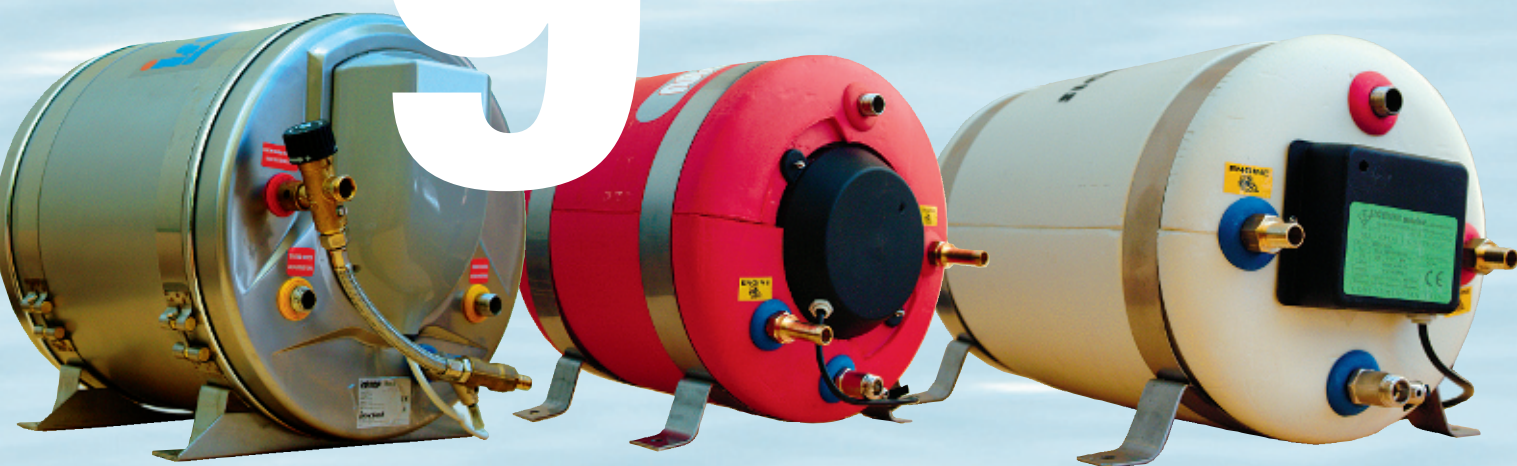


TEST

water heaters in the 20-litre class



Wet heat

home comfort on board

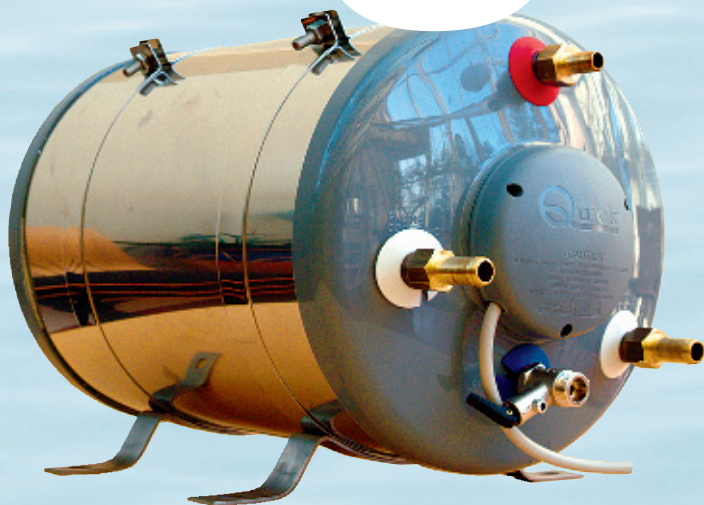
This test of Water Heaters for Yachts has been carried out by the independent Norwegian Boating Magazine BÅTMAGASINET, the leading motor-boat magazine in Scandinavia. The article is written and photographed by Jan Harry Svendsen and reported in issue nr. 7 of BÅTMAGASINET, June/July 2004. This article is reprinted without any changes or comments by Indel Marine Italy, producer of Isotemp Water Heaters. The translation from Norwegian language to English has been made by authorised translator Sprakservice, Member of Swedish Association of Professional Translators.

There are wide differences between water heaters. In the best one, the temperature of the hot water fell by only 3,9 degrees over 12 hours of cooling. The worst of them lost more than 20 degrees and cost the most.



TEST

9 water heaters in the 20-litre class



The difference between a warm, pleasant shower and a cold shower that makes you shiver is no more than 1,35 degrees an hour. While the Isotemp Basic has a heat loss of only 0,33 degrees an hour over 12 hours, the Sigmar Thermoinox loses as much as 1,68 degrees. However, the Sigmar is not the overall loser in the test. It redeems itself by having a slightly higher temperature after the heating cycle has ended than the Webasto, which does not manage to supply a drop of water over 40 degrees after a cooling period of 12 hours.

COOLANT AS HEAT SOURCE

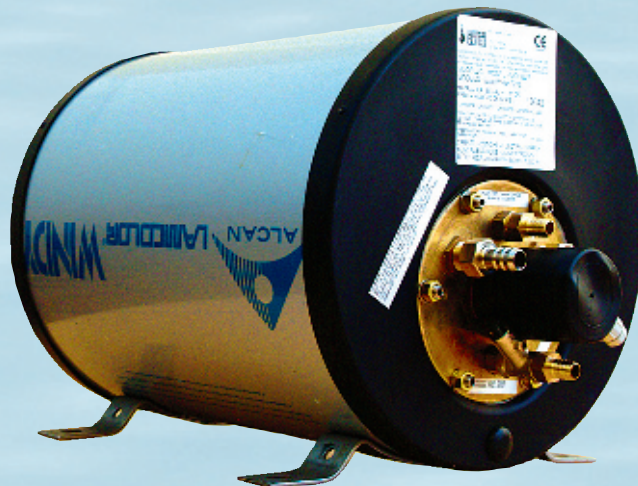
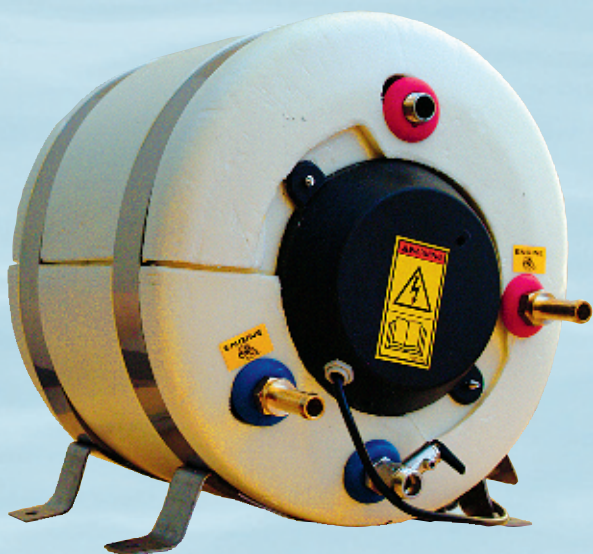
Most of the water heaters in the test have the same basic design idea. An insulated tank is connected to the boat's freshwater system and the engine cooling system. The engine coolant is conveyed through a heat exchanger inside the tank and heats up the water. Most of the tanks are additionally supplied with a heating element which makes it possible to heat up water from the shore power supply.

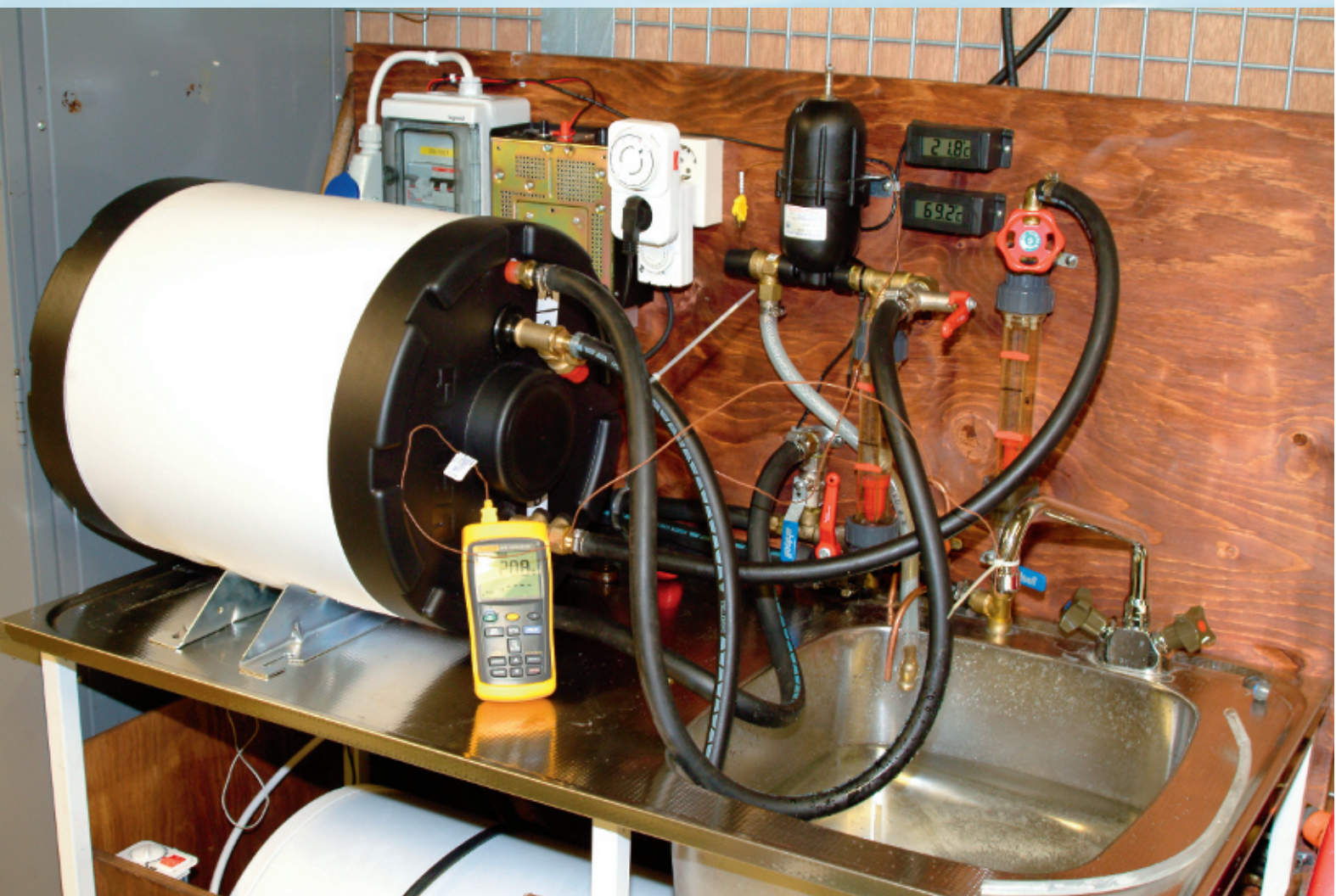
Vetus has chosen a different solution, with two tanks one inside the other. The freshwater is in the inner tank, while the engine coolant circulates in the outer tank. The

drawback of this solution is that the tank is heavy. It weighs as much as 23 kilograms.

ISOTEMP GOOD, WEBASTO DISAPPOINTING

The ATI BB 2212 had the highest temperature after one hour of heating using the heat exchanger, 68,8 degrees. That's more than 20 degrees warmer than the Mobitherm MWH-020 and the QL Water-Heater, with 48,2 and 48,5 degrees respectively. The picture changes when we have left the water heaters standing for twelve hours without heating. Then the Vetus provides the hottest water at 55,2 degrees, while the Webasto





TO ENSURE THAT the test results were repeatable, and that the tanks operated in identical conditions, they were tested on the bench. Here the tank of the Vetus is connected.

20L does not manage to supply water warmer than 39.9 degrees. The limit for a comfortable shower temperature is around 40 degrees.

What is of greatest interest, however, is how many litres of water over 40 degrees the heaters manage to supply after 12 hours of cooling.

Here the Isotemp Basic is in a class of its own. From its 24 litre tank it supplies as much as 23 litres of water at a temperature above 40 degrees. The Vetus is also good with 17 litres from a 20 litre tank. The Isotemp Slim 20 and Quick Nautic Boiler deliver 15 litres. The Sigmar Thermionox and the ATI BB 2212 are disappointing, with nine and eight litres respectively. Both have a capacity of 22 litres. By far the worst is the Webasto. It does not manage to deliver so much as a drop of water above 40 degrees after 12 hours.

MIXER VALVE IS USEFUL

Part of the secret behind the good results achieved by the Isotemp is the mixer valve. Both the Isotemp Slim 20 and the Isotemp Basic have this as standard. Using

a valve it is possible to choose to add cold water to the hot water drained from the heater. Better use is made of the hot water in this way.

Another advantage is that using this valve it is possible to adjust how hot water the heater is to deliver. This reduces the danger of burns, particularly if there are young children on board.

CHECK OUTPUT

All the water heaters in the test, with the exception of the Vetus, were equipped with a heating element as standard. Connecting the hot-water tank to the boat's shore power system ensures that there is also hot water when the boat is moored. With a built-in thermostat, the efficiency of the hot-water tank is like at home. Most of the tanks in the test have heating elements that deliver around 800 Watts. The exception is the ATI, which has a 1,500 Watt element. It is basically a good one, but the drawback is that most shore power systems have many users connected to the same outlet. Too high a wattage in the element may therefore lead to the fuse in the shore power system blowing.

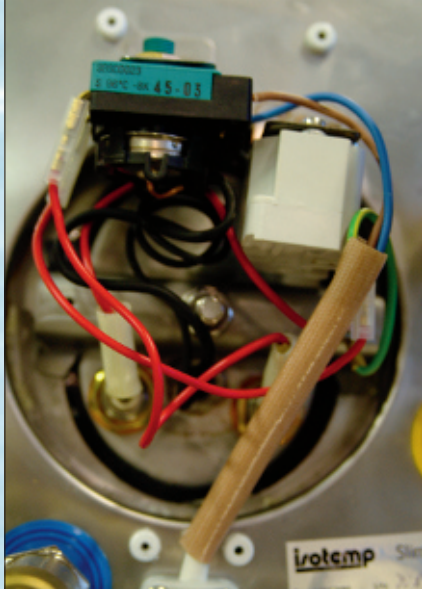


THE TANKS were taken apart so that we could study their construction.

SAFETY THERMOSTAT FAILED

All the heating elements are equipped with a thermostat, and in the vast majority of cases these are adjustable. The exception is the Isotemp, which has a thermostat fixed at 75 degrees. For the water heaters from Sigmar, Mobitherm, QL and Webasto the temperature was a few degrees above the value at which the thermostat was set, while the rest of the tanks were a few degrees below the set temperature.

All the thermostats are additionally



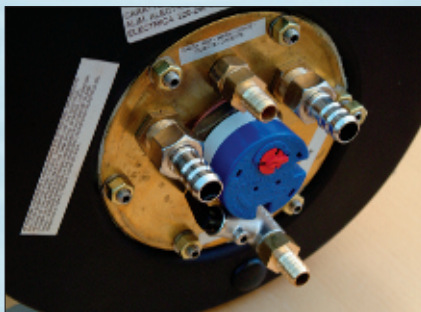
SAFETY THERMOSTAT: The Isotemp is the only water heater in the test with a safety thermostat that works on boiling dry. The blue "box" is the safety thermostat, while the operating thermostat is the white "box".



DRAIN: The tank of the Vetus is drained by unscrewing a plastic lid. This solution will result in waste-water when the tank has to be drained.



SMALL SLEEVE COUPLING: The tank is drained via the small sleeve coupling. Not only does this take a long time, it is also difficult to attach a hose to the sleeve coupling.



THERMOSTAT: All the water heaters in the test with the exception of the Isotemp have an adjustable thermostat. However, the safety thermostat failed on all the thermostats.



MIXER VALVE: The tanks from Isotemp have a mixer valve as standard. The temperature of the water to be supplied by the heater is set here. Cold water is mixed in with the hot water to attain the correct temperature.

equipped with a safety thermostat. This is intended to trip if the water heater is switched on and there is no water in the tank (boiling dry) or if the ordinary operating thermostat fails. Only the Isotemp had a system that worked the way it was meant to. After just under five minutes the safety thermostat tripped on both the Slim 20 and Basic. The element in the Vetus and ATI short-circuited and blew the fuse on the shore power side. On the other water heaters the operating thermostat took over the job of the safety thermostat and switched on and off with an empty tank.

POOR CONNECTING OPTIONS

A combined one-way valve and safety valve is fitted on all the tanks. This valve has several functions, including preventing hot water from running out of the tank. In addition, the valve is used when the water heater is to be drained. The drawback with most of the valves is that the diameter of the drain coupling is too small. This makes it difficult to attach a hose to the valve, and at the same time it takes too long to drain the tank. A welcome exception is the Vetus, which has a valve with a decent connection for a hose on the safety valve. The drawback with the Vetus solution is that they have chosen to have a separate unit to drain the tank. This is done by unscrewing a small plastic lid. This solution is not ideal, and will cause waste-water in the boat.

All the tanks with the exception of the Isotemp and Quick have safety valves that open at a pressure of four bar. The manufacturer's information was in good agreement with our test results during our pressure test. However, it is poor when the ATI and Webasto valves already start to ooze at three bar.

Both the Isotemp and the Quick have valves that do not open until a pressure of

six bar. The deviations between specified opening pressure and actual opening pressure were minimal for these tanks.

SAME MAKE

We have brought together nine different tanks in this test. But four of these tanks are of the same make. Sigmar has produced the tanks for Mobitherm, QL and Webasto. However, there are some differences between the tanks. The Thermionox has a tank capacity of 22 litres, while the Webasto, QL and Mobitherm have 20-litre tanks. Webasto for its part has its own heat exchanger for the connection of external heat, for example a Webasto heater.

The QL and Mobitherm, on the other hand, are completely identical tanks, which our test results also show to be the case. They track each other with regard to both the number of litres above 40 degrees the tank can deliver and the temperature after heating has ended. The heat loss is also identical for the two tanks. It might be thought that identical tanks would cost the same. They do not. The QL costs NOK 3.125, while the Mobitherm carries a price tag of NOK 3.750. Mobitherm thus charges NOK 600 more than QL for exactly the same tank (1 € ≈ 8,5 NOK).

ISOTEMP BEST

This test provides ample proof that expensive is not always best. The Webasto 20 L is the most expensive and worst tank in the test. The Isotemp Basic is the best. With its tank capacity of 24 litres, it delivers 23 litres of water at a temperature above 40 degrees after a cooling period of 12 hours. The Basic costs NOK 3.350, but a mixer valve comes as standard. Vetus is also a tank with good performance. No less than 17 litres from its 20-litre tank is good, but the tank is both expensive

and heavy. Vetus charge no less than NOK 3.855 for their tank and if you want a heating element the price rises to NOK 4.617. The Quick Nautic Boiler offers a lot for the money. With a guide price of NOK 2.350 it is the most inexpensive tank in the test. The 20-litre tank nevertheless delivers 15 litres of hot water, and in material selection it is superior to the other tanks in the test. Stainless steel (AISI 316) is used in the tank, heating coil and in the casing around the tank. Despite low price, good performance and quality materials, the tank of the Quick comes third because the safety thermostat did not trip in the boiling-dry test. The Quick is therefore beaten by the Isotemp Slim 20. Its performance is the same as that of the Quick with regard to hot water, but the Slim 20 has a mixer thermostat as standard and has a safety thermostat that works. The drawback is the price. The Isotemp costs nearly NOK 1.000 more than the Quick.

Modest performance and a high price should make the tanks from both QL and Mobitherm uninteresting. The Isotemp Slim 20, for example, is cheaper to buy than the Mobitherm MWH-20.

Both the Sigmar Thermionox and the ATI BB2212 have a capacity of 22 litres. However, they do not manage to deliver more than nine and eight litres of water respectively at a temperature above 40 degrees. The only tank worse than these is the Webasto 20 L, which does not provide a drop of water warmer than 40 degrees. The price is also very high, so you need to have a very good reason to choose the Webasto tank.

Test winner



Isotemp Basic 24 Price: NOK 3.350

The ISOTEMP BASIC has good labelling to show where the various hoses are to be connected.



CONCLUSION

The Isotemp Basic is the winner in the test. It supplies a lot of hot water in relation to its size and has low heat loss. The water heater is well put together in all its details, and has a high level of equipment. A mixer valve, for example, is standard.

The Isotemp Basic has a tank capacity of 24 litres. It can be mounted horizontally and vertically, but in that case with the connection points facing down. The water heater has very strong feet that are spot-welded to a strap that goes round the tank. Mixer thermostat and heating element are standard.

Both the tank and the heat exchanger are made of high-grade

acid-proof steel (AISI 316). A casing, made of non-magnetic stainless steel (AISI 304) protects the tank's insulation. The insulation is of polyurethane foam.

The thermostat of the heating element is not adjustable, but is programmed to trip at 75 degrees. The safety thermostat works as intended on boiling dry, and trips quickly. It has to be reset manually.

THE CONSTRUCTION makes no compromises. The heat exchanger goes in several loops, and the heating element is angled downwards for optimum output.

The Isotemp Basic has low heat loss. After 12 hours the total heat loss was only 3.9 degrees. That gives an average heat loss per hour of only 0.33 degrees. After one hour of engine running we measured the water

temperature at 55.8 degrees. This is relatively modest, when the temperature of the water that circulated through the heat exchanger had a temperature of 70 degrees. However, the capacity of the water heater is impressive. After 12 hours of cooling, the tank delivers as much as 23 litres of water at a temperature above 40 degrees.

CONCLUSION

The Isotemp Slim 20 is a good hot-water tank. Its modest dimensions mean that it also fits into tight spaces.

The water heater has a high level of equipment and has useful capacity.

◆ **THE CONSTRUCTION of the Slim 20 L is identical to the Basic. Here too the heating element is angled down, but because the tank is smaller the heating coil has fewer loops.**



Isotemp Slim 20 Price: NOK 3.265

CONNECTION is straightforward, thanks to good labelling of the various connection points.



The Isotemp Slim 20 has a tank capacity of 20 litres. It can be mounted horizontally and vertically, but in that case with the connection points facing down. The water heater has strong feet that are spot-welded to a strap that goes round the tank. Mixer thermostat and heating element are standard.

Both the tank and heat exchanger are made of high-quality acid-proof steel (AISI 316). A casing protects the insulation. The insulation is of polyurethane foam.

The thermostat of the heating element is not adjustable, but is programmed to trip at 75 degrees. The safety thermostat works as intended

on boiling dry, and trips quickly. It has to be reset manually.

The Isotemp Slim 20 has an average heat loss; after 12 hours the total heat loss was 12.1 degrees. It provides an average heat loss of one degree per hour. After running for one hour we measured the water temperature at 62.7 degrees. The

capacity of the water heater is approved. After 12 hours of cooling, the tank delivers 15 litres of water at a temperature above 40 degrees.

CONCLUSION

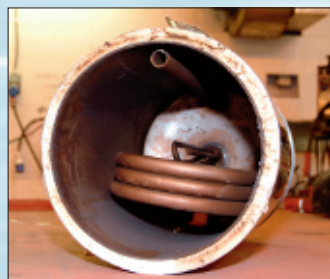
The Quick Nautic Boiler is a good hot-water tank.

The tank is reasonably priced, but is costly in choice of material. It has useful capacity and an efficient heat exchanger. A disappointment is the safety thermostat, which does not work as intended.

◆ **THE HEATING COIL is strong and well dimensioned. The water heater ought to have had rather better insulation.**



Quick Nautic Boiler Price: NOK 2.350



The Quick Nautic Boiler has a tank capacity of 20 litres and can be mounted horizontally and vertically. The water heater has simple feet welded to a strap that goes round the tank. Heating element is standard equipment.

Both the tank and the heat exchanger are made of acid-proof steel (AISI 316). A casing, also of acid-proof

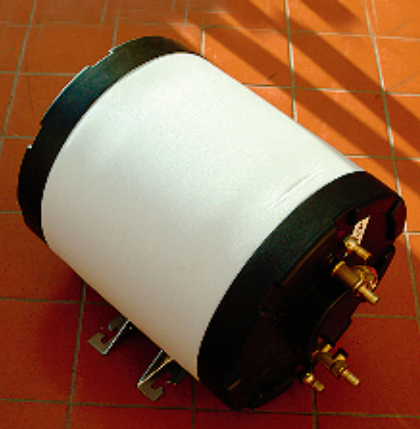
THE QUICK has a clear front, with good labelling. The fact that the text is cast into the plate means that problems with glued-on slips are avoided.

of steel (AISI 316), protects the tank's insulation, which is made of polyurethane foam.

The thermostat of the heating element is adjustable in the 20-80 degree range.

The safety thermostat is integrated into the thermostat housing which sits on the outside the tank. This works poorly because the sensor is too far away from the heating element. During our test the water heater knocked against the operating thermostat on boiling dry. In other words, the safety thermostat did not work as intended.

The Quick Nautic Boiler has relatively high heat loss; after 12 hours the total heat loss was 15,6 degrees. This gives an average heat loss per hour of 1,3 degrees. After one hour of engine running, we measured the water temperature at 64,3 degrees. The capacity of the water heater is approved. After 12 hours of cooling the tank delivers 15 litres of water at a temperature above 40 degrees.

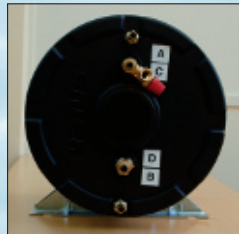


The Vetu has a tank capacity of 20 litres and can be mounted horizontally and vertically. The water heater has strong feet screwed into the tank itself. A heating element is not standard, despite the high price of the water heater.

The design of the Vetu differs radically from the other tanks in the test. There is an inner tank and an

Vetus WH20A Price: NOK 3.855

THE LABELLING of the connection points is useful. However, the distinctive design of the tank makes correct fitting very important.



outer tank in which the engine coolant circulates. The inner tank is made of non-magnetic stainless steel (AISI 304). The outer tank is made of steel. The design of the tank makes it very heavy. The insulation is polyurethane foam with a casing of vinyl, but there is polystyrene at each end.

The heating element is adjustable in the 40 to 80 degree range. A built-

in safety thermostat is intended to protect against boiling dry, but the element short-circuited before the thermostat tripped.

The Vetu has a low water loss; after twelve hours the total water loss was 7.8 degrees. This results in an average water loss per hour of 0.65 degrees. After an hour of engine running we measured the water tem-

CONCLUSION

Vetus supplies a tank with solid performance. Its capacity is very good and it has low heat loss. However, the tank is too expensive; with an electric heating element it costs NOK 4.617. Its design also makes the tank heavy.

♦ **DOUBLE:** The Vetu has an inner and an outer tank, with the engine coolant circulating in the outer tank. Its design makes the tank heavy.

perature at 63 degrees. The capacity of the water heater is very good. After 12 hours of cooling the tank delivers 17 litres of water at a temperature above 40 degrees.



The QL Water Heater has a tank capacity of 20 litres and can be mounted horizontally and vertically. The water heater has simple feet that are spot-welded to a strap that goes round the tank.

Both the tank and the heat exchanger are made of acid-proof steel (AISI 316). The insulation is of polyurethane foam, but is not equipped

QL Water Heater Price: NOK 3.125

THE CONNECTION POINTS are usefully labelled. The insulation is un-protected.



with any protective casing.

The thermostat of the heating element is adjustable; the temperature range is from 30 to 80 degrees. The safety mechanism does not work as intended on boiling dry; the sensor is located too far away from the heating element. The result is that the water heater knocks against the operating thermostat.

THE CONSTRUCTION of the tank is simple, and the material is acid-proof of steel (AISI 316). The heat exchanger is very rudimentary, as the test results also show.

The QL Water Heater has low water loss; after 12 hours the total water loss was 5.9 degrees. This gives a total heat loss per hour of 0.49 degrees. An inefficient heating coil contri-

CONCLUSION

The QL Water Heater is a simple hot-water tank. The heating loop is U-shaped and therefore makes poor use of the coolant. Only 12 litres of hot water above 40 degrees is also on the low side. The tank is identical to the Mobitherm MWH-020.

butes to the water in the water heater having the lowest temperature, together with the Mobitherm, after one hour of engine running. The temperature is only 48.5 degrees. After 12 hours of cooling the tank delivered 12 litres of water at a temperature above 40 degrees.



The Mobitherm has a capacity of 20 litres, and can be mounted horizontally and vertically. The water heater has simple feet spot-welded to a strap that goes round the tank. Both the tank and heat exchanger are made of high-quality acid-proof steel (AISI 316). The insulation is of polyurethane foam, but is not equipped with any protective casing.

Mobitherm MWH-020 Price: NOK 3.750



USEFUL labelling of the connection points on the tank. The insulation is unprotected.

The thermostat of the heating element is adjustable; the temperature range is from 30 to 80 degrees.

The safety thermostat does not work as intended on boiling dry; the sensor is located too far away from the heating element. The result is

SIMPLE CONSTRUCTION, and the material is acid-proof AISI 316 steel. The test shows that the heat exchanger is rudimentary. The tank is identical to the QL.

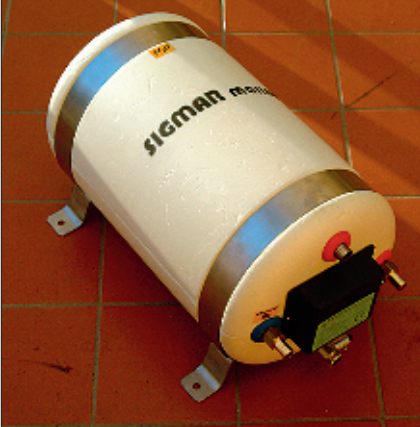
that the water heater knocks against the operating thermostat.

The Mobitherm Cal 020 has low heat loss; after 12 hours the total heat loss was 5,3 degrees. This gi-

CONCLUSION

The QL Water Heater is a simple hot-water tank. The heat coil is U-shaped and thus makes poor use of the coolant. Only 12 litres of hot water above 40 degrees is on the low side. The tank is identical to the QL Water Heater.

ves an average heat loss per hour of 0,44 degrees. An inefficient heat coil contributes to the water in the water heater having the lowest temperature, together with the QL, after one hour of engine running. The temperature is only 48,2 degrees. After 12 hours of cooling the tank delivered 12 litres of water at a temperature above 40 degrees.



Sigmar Thermoinox

Price: 2.575



The Sigmar Thermoinox has capacity of 22 litres, and can be mounted horizontally and vertically. The water heater has simple feet that are spot-welded to a strap that goes round the tank.

Both the tank and the heat exchanger are made of acid-proof steel (AISI 316). The insulation is polyurethane foam, but the water heater is

POOR insulation on the Sigmar Thermoinox, but the connection points are well labelled.

not equipped with any protective casing.

The thermostat of the heating element is adjustable from 30 to 80 degrees. The safety thermostat does not work as intended on boiling dry. The water heater knocks against

SIMPLE TANK. The heat coil is a simple U, and the water heater has high heat loss.

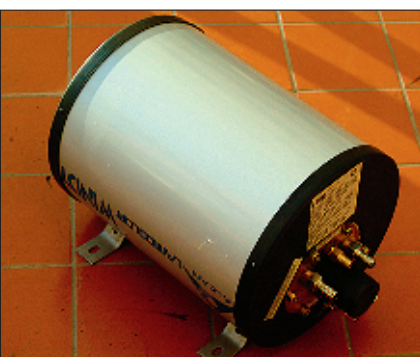
the operating thermostat. Here too the sensor for the thermostat is located too far away from the heating element.

The Sigmar Thermoinox has the highest heat loss in the test. After 12 hours the total heat loss was

CONCLUSION

The Sigmar Thermoinox is a simple water heater. The choice of material is good, but the insulation can be improved. A heat loss of more than 20 degrees over 12 hours is scandalous. Its capacity is also very poor. The water heater only managed to deliver nine litres of hot water from its tank of 22 litres.

20,1 degrees. This gives an average heat loss per hour of 1,68 degrees. After one hour of engine running the water heater delivers water at a temperature of 60,6 degrees. The capacity is, however, lamentable. The water heater only manages to deliver nine litres of water above 40 degrees.



ATI BB 2212

Price: NOK 2.530



The ATI has capacity of 22 litres and can be mounted horizontally and vertically. The water heater has simple feet that must be screwed onto the straps that go round the tank.

The tank is made of steel, but the surface is enamelled and heat-treated at 860 degrees. The heat exchanger is made of copper and the insulation is made of polyurethane. A casing of anodised, sea-water-re-

THE CONNECTIONS on the tank of the ATI ought to have been labelled better. The ATI is the only tank in the test to use 3/8 inch couplings on the inlet and outlet of the fresh-water side.

sistant aluminium protects the insulation.

The thermostat of the heating element is adjustable in the range from 0 to 70 degrees. The safety thermostat does not work as intended on boiling

dry, because the heating element short-circuits. The ATI is the only tank in the test to have a zinc anode fitted as standard on the heating element.

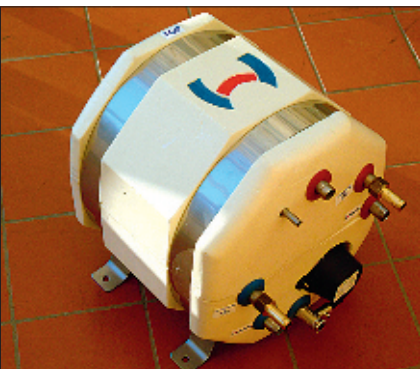
The ATI has high heat loss. After 12 hours the total heat loss was 19.2 degrees. This gives an average heat loss of 1.6 degrees per hour. On the other hand, the water heater has the highest water temperature after

CONCLUSION

The ATI BB 2212 is a hot-water tank with an unusual choice of materials. Instead of acid-proof steel, the inside of the steel tank has been enamelled. A plus point for a powerful heat exchanger, but the capacity of the tank is inadequate.

↓ **OVER-DIMENSIONED** heat exchanger for optimum utilisation of the engine coolant. Unfortunately the tank has high heat loss and poor capacity.

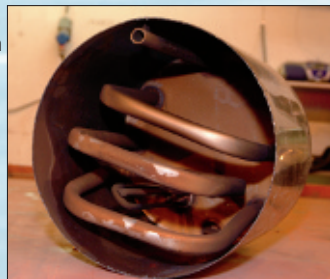
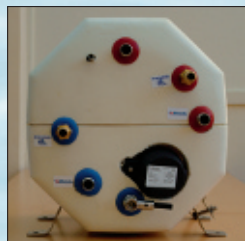
one hour of heating. We measured the temperature as being as high as 68.8 degrees. A decent heat exchanger with as many as 16 loops is responsible for the good result. Unfortunately the capacity of the tank is not good. It only manages to deliver eight litres of water above 40 degrees.



Webasto 20 L

Price: NOK 4.340

THE WEBASTO'S tank has many connection points with good labelling.



The Webasto has a capacity of 20 litres and can be mounted horizontally and vertically. The water heater has simple feet spot-welded to straps that go round the tank.

Both the tank and the heat exchanger are made of acid-proof steel (AISI 316). The insulation is made of polyurethane foam, but it is not equipped with any protective casing.

In addition to the heat exchanger which is connected to the engine cooling system, the water heater has its own heat exchanger for the connection of external heat, for example Webasto boat heaters.

The thermostat of the heating element is adjustable; the temperature range is from 30 to 80 degrees.

The safety thermostat does not work

OWN HEAT COIL for use together with boat heaters. The high location of the heat exchanger that circulates the engine coolant contributes to the poor test result.

as intended on boiling dry. The water heater knocks against the operating thermostat. This happens because the sensor of the thermostat is located too far away from the element.

CONCLUSION

The Webasto 20 L is the big surprise in the test. It might be thought that the name would oblige. It evidently does not do so in this case. The capacity of the tank is below criticism; it does not manage to deliver a drop of water above 40 degrees. In addition, its price is far too high.

The Webasto 20 L has relatively high heat loss. After 12 hours the total heat loss is 17,3 degrees. This gives an average heat loss per hour of 1,44 degrees. The water temperature after one hour of engine running is 57,2 degrees. It is disappointing that the tank does not deliver water above 40 degrees after 12 hours of cooling.

How we performed the test

The test was performed in the heavy laboratory of the Department of Maritime Sciences at Vestfold University College (HIVE) in Horten. A Fluke 54 II temperature gauge was used as measuring equipment. The instrument was calibrated in a liquid bath at IKM Laboratorier in Tananger. In addition, a pressure gauge was used during the pressure testing of the tanks. The pressure gauge is accurate to +/- 5 per cent.

A test bench was used during the test. A hot water tank with a 3.000 Watt heating element delivers "coolant" at a temperature of 70 degrees. A circulating pump was used to circulate the coolant through the heat exchanger in the water heaters. The speed of the pumps could be regulated, and they could be adjusted so that the flow through the heat exchanger of the tank was 3 litres a minute. The tanks were fitted and connected before each test. They were then filled with freshwater at a temperature of 20 degrees before circulation of "coolant" was started. The circulation was interrupted after an hour, when precisely one litre of cold water (20 degrees) was added through the freshwater inlet of the tank. This

simulates a natural cycle as found on a board leisure craft. The temperature was measured. The circulation of the engine coolant was then started up again to equalise the temperature drop which the one litre of cold water had brought about. The circulation this time was interrupted after half an hour. The tank was then left standing for 12 hours to simulate a night on board. Cold water was added to the tank after 12 hours with a flow rate of four litres a minute. The temperature was measured for each 15 seconds, or for each litre drained from the tank.

The test on the heating elements of the tanks was carried out by setting the thermostat to max. The tank was then filled with water at a temperature of 20 degrees and then it was plugged in. The temperature as measured when the thermostat tripped for the first time. The test on the safety thermostat was carried out by the tank being connected to the power source WITHOUT there being water in the water heater. The time before the safety thermostat tripped was then measured. Several of the tanks did not pass the test, and for these the test was terminated after 30 minutes.

The pressure test on the safety valve was undertaken by filling the tanks with water and then adding compressed air. The compressed air was let into the tank by means of a valve,

with a pressure increase of 0.1 bar.

Measurements were performed when the valve started to ooze water and when there was full opening.

The test was performed in March and April 2004.



MEASUREMENTS WATER HEATERS IN THE 20-LITRE CLASS

Water heater:	Isotemp Basic	Isotemp Slim 20	Quick Nautic Boiler	Vetus WH20A	QL Water Heater	Mobitherm MWH-020	Sigmar Therminox	ATI BB 2212	Webasto 20L
Temp after 1 hour engine running:	55,8°	62,7°	64,3°	63°	48,5°	48,2°	60,6°	68,6°	57,2°
Temp after 12 h cooling:	51,9°	50,6°	48,7°	55,2°	42,6°	42,9°	40,5°	49,6°	39,9°
Heat loss:	3,9°	12,1°	15,6°	7,8°	5,9°	5,3°	20,1°	19,2°	17,3°
Heat loss degrees per hour:	0,33°	1°	1,3°	0,65°	0,49°	0,44°	1,68°	1,6°	1,44°
No, litres water above 40 degrees:	23 litres	15 litres	15 litres	17 litres	12 litres	12 litres	9 litres	8 litres	0 litres
Temp, with heating element:	69,6°	67,2°	78,3°	66,2°	82,3°	82,8°	83,9°	62,5°	81,1°
Time before safety thermostat trips:	4 min 50 sec	4 min 01 sec	–	Element short-circuits	–	–	–	Element short-circuits	–
Residual water after draining:	0,2 litres	0,4 litres	0,78 litres	2,65 litres	0,76 litres	0,1 litres	0,92 litres	3,65 litres	0,68 litres
TECHNICAL DATA									
Volume:	24 litres	20 litres	20 litres	20 litres	20 litres	20 litres	22 litres	22 litres	20 litres
Length:	480 mm	660 mm	505 mm	540 mm	387 mm	391 mm	538 mm	492 mm	401 mm
Width:	395 mm	287 mm	327 mm	406 mm	352 mm	351 mm	299 mm	318 mm	347 mm
Height:	400 mm	302 mm	313 mm	430 mm	395 mm	374 mm	299 mm	326 mm	384 mm
Weight:	11 kg	11,5 kg	10,9 kg	23 kg	9 kg	8 kg	11 kg	14 kg	9 kg
Heating element output:	750 watt	750 watt	500 watt	1.000 watt	800 watt	800 watt	800 watt	1,200 watt	800 watt
Opening of safety valve:									
Oozing:	6 bar	5,6 bar	5,6 bar	4,2 bar	3,9 bar	3,6 bar	3,7 bar	3 bar	3,1 bar
Full opening: >	6 bar	6 bar	5,8 bar	4,4 bar	4,3 bar	4,4 bar	4,2 bar	4 bar	3,7 bar
Diameter of couplings:									
Heat exchanger:	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"
Inlet cold water:	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	3/8"	1/2"
Outlet hot water:	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	3/8"	1/2"
Price (1€ = 8,5 NOK):	3,350	3,265	2,350	3,855	3,125	3,750	2,575	2,530	4,340