Hour Glass

Multi-Chamber Radiator Tubes – High Performance Radiators

DOLPHIN

Hour Glass

MULTI-CHAMBER RADIATOR TUBES

Driven by the rapid technical and technological development as well as ever increasing emission regulation schemes the demands for engine cooling modules and systems are constantly increasing. Thermal management plays a major role in terms of fuel efficiency but also as a means to achieve required emission levels as well as driving comfort.

The optimum heat exchanger design – whether it is a radiator or intercooler – is a **compact**, **reliable** and **light weight**, with the highest possible **performance**, and **economic footprint**.

There are various ways to improve the thermal performance of heat exchanger – which is a combination between heat rejection and pressure drop. Thermal designer can work with geometrical parameters of heat transfer surfaces and components which are influencing on performance: optimizing fin efficiency and air flow behavior around the fins as one example. Louvered fins are commonly used in many compact heat exchangers to increase the surface area and initiate new boundary layer growth. Another important element from both reliability and performance point of view is the tube design – besides being a major factor in terms of internal pressure drop, the tube design has an impact to hydraulic diameter and different mass flow patterns. Also by optimizing the geometrical design parameter surface area (the area of the tube touching the air-side fin and transferring heat) it is possible to increase the performance of the heat exchanger.

To respond to these requirements Dolphin Group has introduced so called multi-chamber radiator tubes which are HF-welded using high performance and strength aluminum alloys AA 4343 10%, 3003, 7072 10%, H14. There are three design options: 40 mm, 48 mm and 54 mm (x 1.8 mm) combine with louver fins. Multi-chamber radiator tube design enables to create an uninterrupted heat flow medium from coolant to air with maximized surface area unlike conventional multi row tube radiators, these multi chamber tubes provide high conduction heat transfer due to larger surface contact of fins and tubes. This provides a substantial opportunity to improve e.g. truck, commercial vehicle and performance car radiators.

BENEFITS

- **Reduced core thickness / size for tighter space constraints**
- **Reduced manufacturing expenditures required for the heat exchanger arrangement**
- **Superior strength and increased mechanical stability for high-pressure and -performance applications**
- **Wider tubes without spacing and curved edges providing greater surface contact with the fins and this way conducting heat more efficiently than standard tube designs**
- **Fully brazed single metal construction enables to optimize the fatigue properties**
- **High Specific Heat Exchange (kW/m²°C)**
- **High Heat Exchanger Effectiveness (ε)**
- **Heat Dissipation (kW) up to 10 % high than conventional tube / fin design.**

3 Design Options

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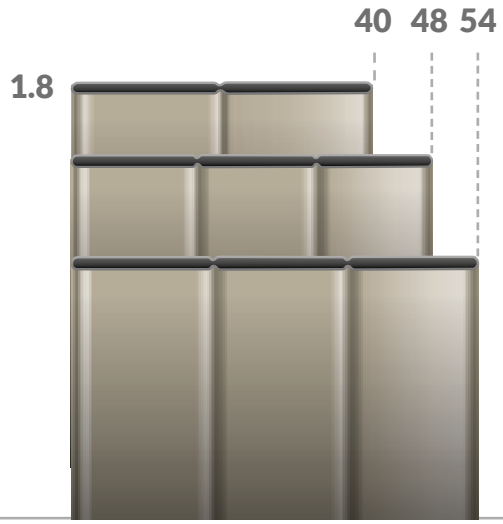
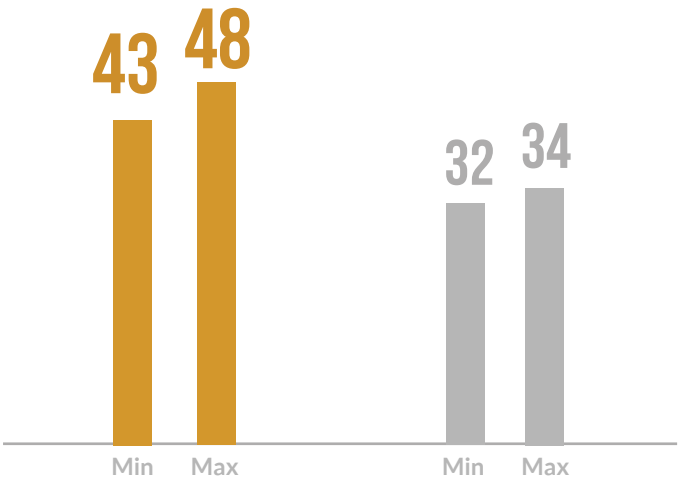


HG 40 · HG 48 · HG 54

Burst Pressure

Burst Pressure of the Tubes



Hour Glass
40mm × 1.8mm × 0.28mm

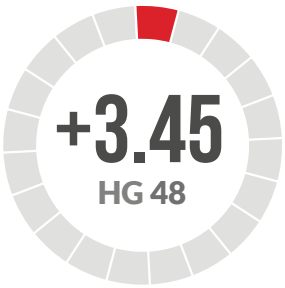
Conventional
40mm × 2mm × 0.32mm

BURST PRESSURE IN BAR (Actual)

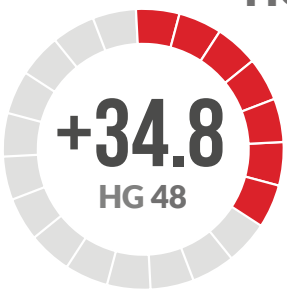
Heat Rejection %

Core Area %

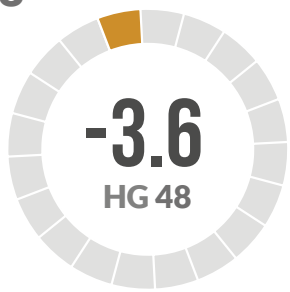
HG 48



Hour Glass 48mm vs. aluminum welded tube 48mm



Hour Glass 48mm vs. Copper Brass XM45



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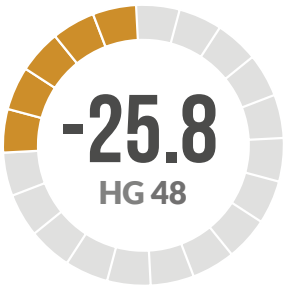
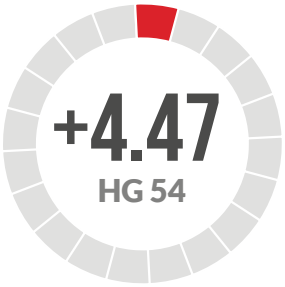
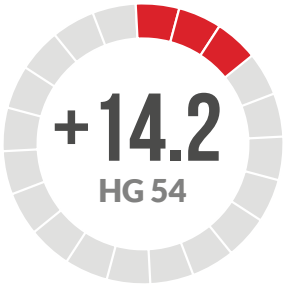


Hour Glass 48mm vs. Copper Brass XM45

HG 54

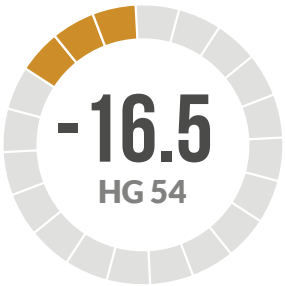


Hour Glass 54 mm vs. aluminum welded tube 54mm



Hour Glass 54 mm vs. Copper Brass XM61

Hour Glass 54 mm vs. aluminum welded tube 54mm



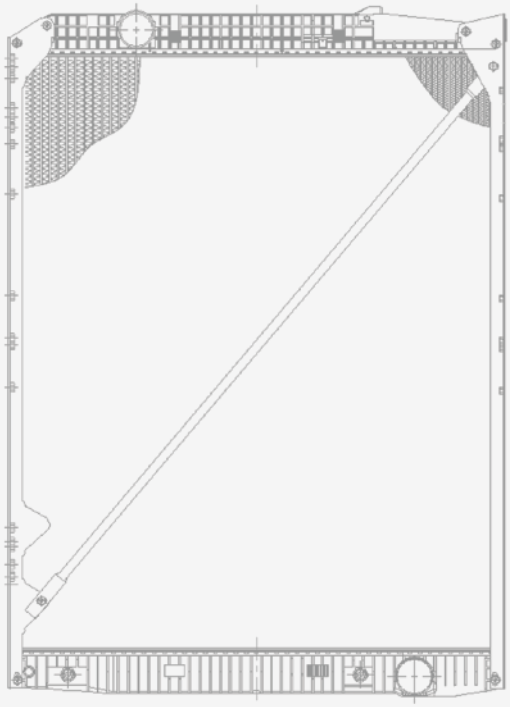
Hour Glass 54 mm vs. Copper Brass XM61

Wind Tunnel Tests

HG 48 • HG 54

ASSUMPTIONS

- Velocity and temperature of coolant and air at the entrance of the radiator core is uniform.
- There are no phase changes (condensation & Boiling) in all fluid streams.
- Fluid flow rate is uniformly distributed through the core in each pass on each fluid side.
- Inner cross section of tube through length of core assume as uniforml y.
- Thermal co efficient of fluids acts uniform full length of radiator.



HG 48

PHYSICAL PARAMETERS

	Hour Glass 48mm (1 Row)	Aluminum Welded -48mm (2 Rows)	Cu.Br-XM 45mm (3 Rows)
No of tubes	58	116	162
Tube size	48 x 1.8x0.3	22 x 2x0.28	12.22 x 2.57x0.12
Fin size	48 x 0.1	48 x 0.1	45 x 0.035
Core Height	780	780	780
Core face area in m^2	0.459	0.459	0.445
Core volume in m^3	0.022	0.022	0.0200

HG 54

PHYSICAL PARAMETERS

	Hour Glass 54mm (1 Row)	Aluminum Welded -54mm (2 Rows)	Cu.Br-XM 61mm (4 Rows)
No of tubes	58	116	216
Tube size	54 x 1.8x0.3	23.45 x 2x0.28	12.22 x 2.57x0.12
Fin size	54 x 0.1	54 x 0.1	61 x 0.035
Core Height	780	780	780
Core face area in m^2	0.459	0.459	0.445
Core volume in m^3	0.0248	0.0248	0.0271

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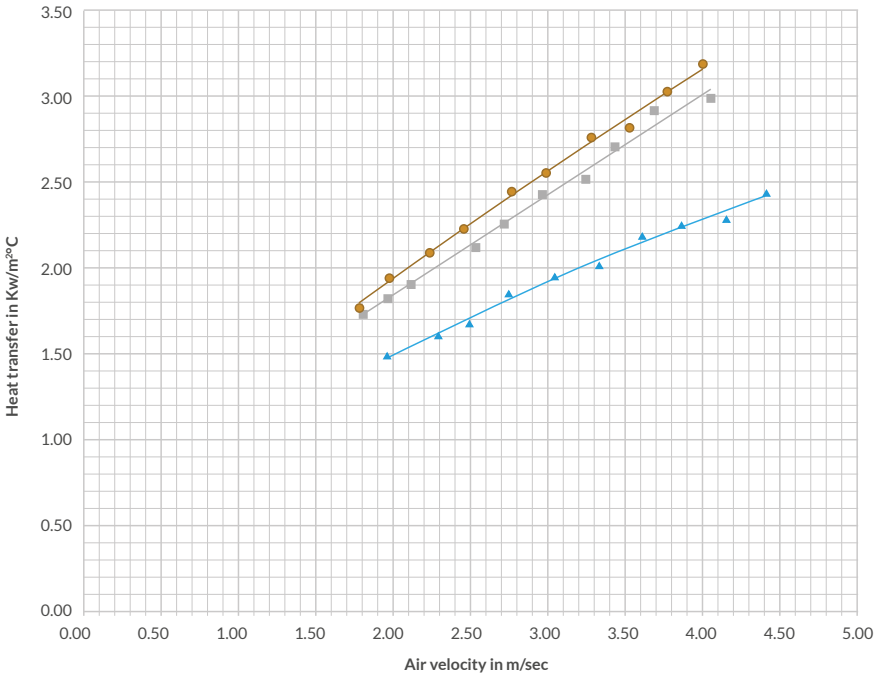
HEAT TRANSFER RATE VS AIR VELOCITY

Performance comparison

Water flow rate	100 LPM
Water inlet temperature	90°C
Ambient	30°C

- HG 48
- Aluminum Welded 48
- Copper Brass XM45



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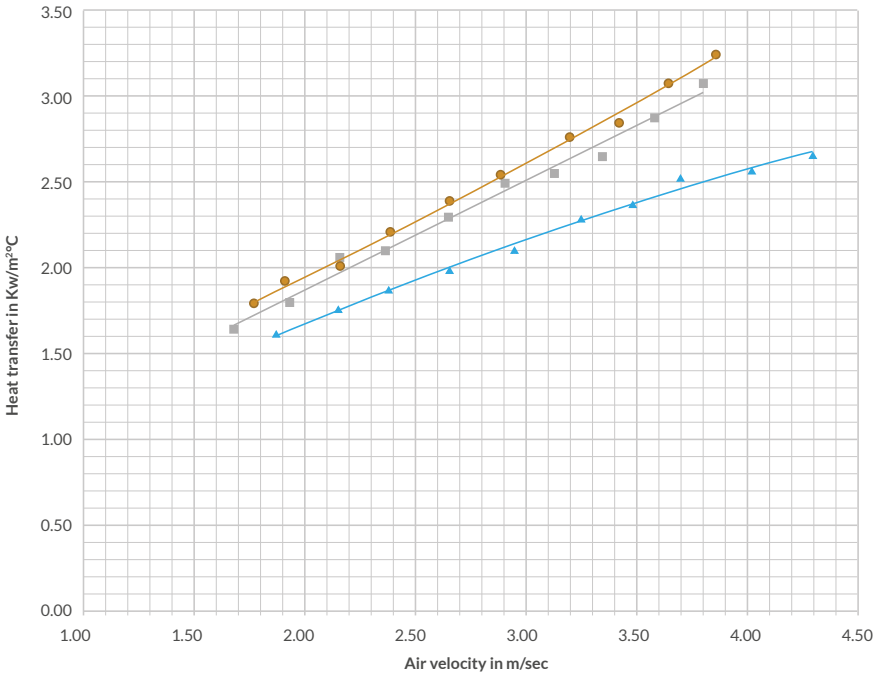
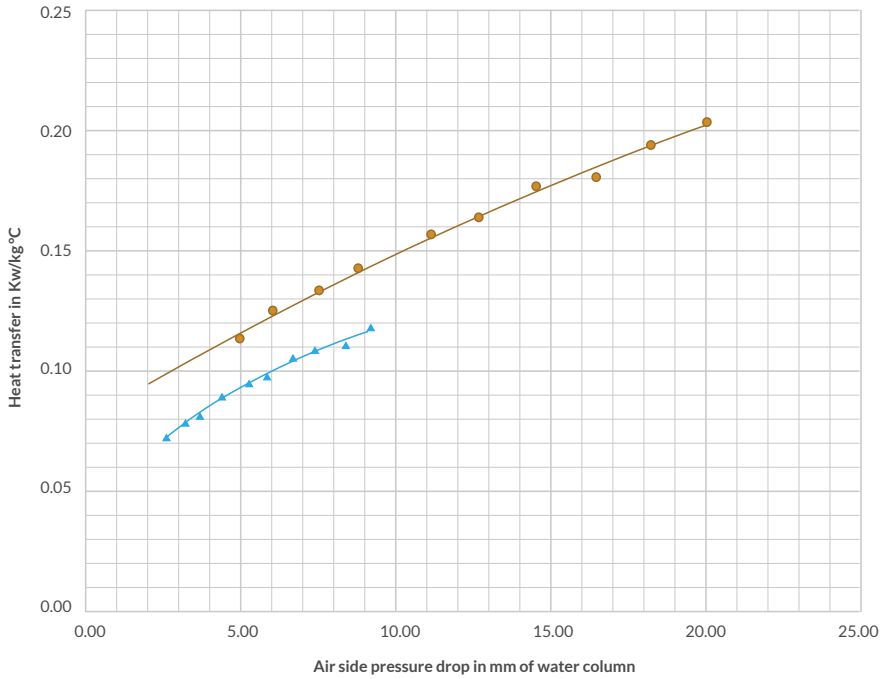


HG 48

HEAT TRANSFER RATE kW/Kg°C VS AIR SIDE PRESSURE D ROP (MM OF WATER COLUMN)

Advantages over copper brass material

- HG 48
- Copper Brass XM45



HG 54

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- HG 54
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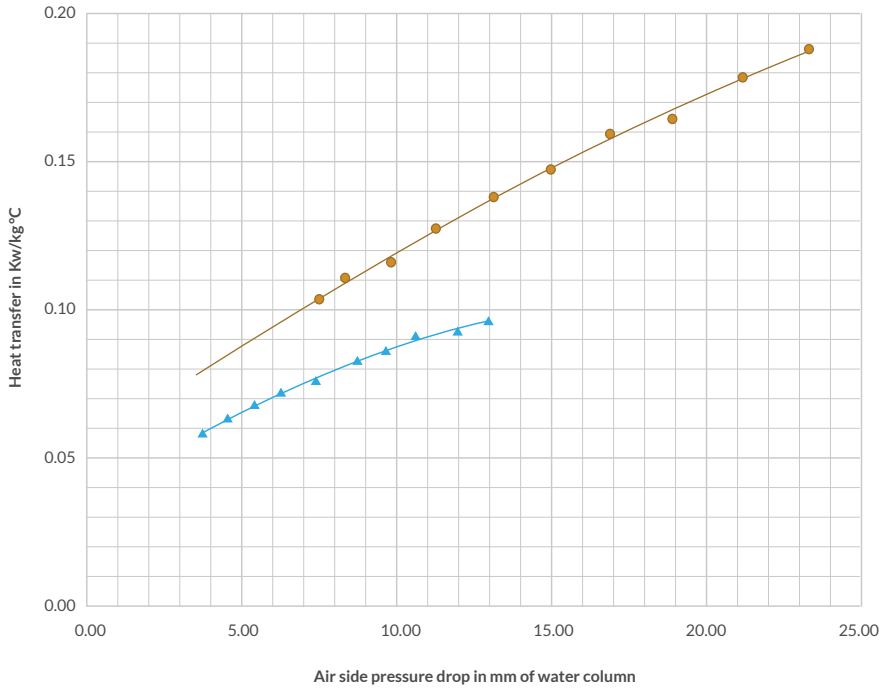

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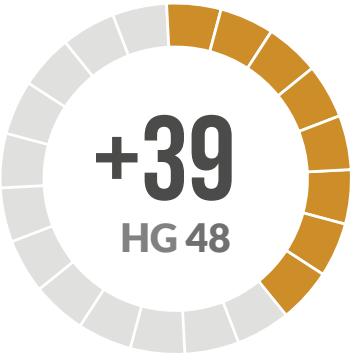
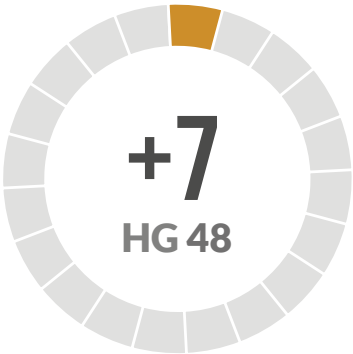
Conclusion HG 48

Specific Heat Dissipation (kW/m² °C)



Specific Heat Dissipation (kW/m² °C) of Hour Glass-48 mm is 39 % more than Copper Brass XM-45 mm

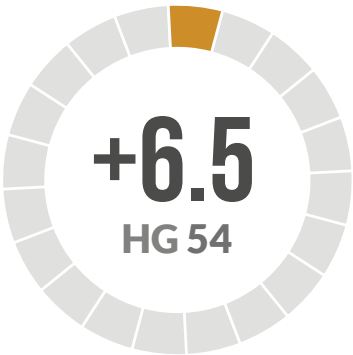


Specific Heat Dissipation (kW/m² °C) of Hour Glass-48 mm is 7 % more than Aluminum Welded-48 mm

Conclusion HG 54

Specific Heat Dissipation (kW/m² °C)

Specific Heat Dissipation (kW/m² °C) of Hour Glass-54 mm is 31 % more than Copper Brass XM-61 mm



Specific Heat Dissipation (kW/m² °C) of Hour Glass-54 mm is 6.5 % more than Aluminum Welded-54 mm

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Our international sales team is at your service and provides you with customized engineered solutions to help improve your operations through our technical capabilities and knowledge

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