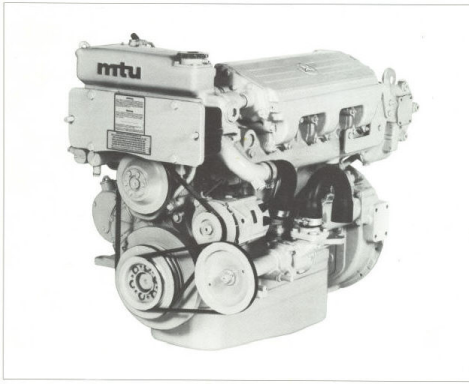
Standard Quotation

099 AZ/TA/TE 51

Propulsion Engines
for Marine Gensets



mtu
Deutsche Aerospace

Engine Description

Series 099 engines are based on Mercedes-Benz's Series 300 industrial and vehicular engines, which have proven their worth by the hundred thousands on a global scale, setting quality standards in a multitude of applications. They have been marinized by MTU through development and selection of application-specific engine components.

Essential marinization features:

- Newly designed auxiliary PTO with integrated raw water pump
- Titanium plate-core heat exchanger for coolant recooling, and integrated expansion tank
- Split-circuit coolant system
- Liquid-cooled exhaust manifold and turbocharger
- Electrical equipment (generator, starter, monitoring system)
- Air intake system
- Resilient mounting

Application-related accessories and ready-to-install plant concepts complement the marinization kit.

Mercedes-Benz technology and the wealth of experience that MTU has gained over decades in marine propulsion translate into renowned power system solutions backed by worldwide Product Support.

Design Features

- AZ variant: naturally aspirated
  TA variant: turbocharged
  TE variant: turbocharged and internally intercooled
- Alloyed grey cast-iron crankcase with reinforcing ribs for added rigidity. Sheet-metal oil pan. Bolted-on gear case and flywheel housing with SAE No. 3 (2) flange.
- Liquid-cooled exhaust manifold and turbocharger (linked up with engine coolant circuit).
- Single-unit, particularly rigid cylinder head of alloyed grey cast-iron with shrink-fitted valve seat inserts. 1 inlet and 1 exhaust valve of heat-resistant alloy steel per cylinder. Hard chromium-plated valve stems run in press-fitted grey cast-iron guides.
- Precision-forged crankshaft with hardened journal fillets and bolt-on counterweights. Triple-layer sleeve bearings with steel backing shells. Torsional vibration damper at the aux. PTO end (dependent on torsional vibration computation).
- Precision-forged, angle-split conrods serrated at the split line. Triple-layer sleeve bearings with steel backing shells. Wear-resistant bronze bushing for piston pin.
- Centrifugally cast dry-type, special-alloy, replaceable cylinder liners on turbocharged engines. On naturally aspirated engines, pistons run directly in the crankcase where special honing ensures a uniform oil film and good wearing qualities.
- Lightmetal pistons with one compression, one combined compression / oil control and one oil control ring. Cast-in insert in top groove. Internal piston cooling on turbocharged engines via fixed oil spray nozzle. Piston-conrod removal from above.
- Valves operated through gear-driven camshaft (cam lubrication via spray nozzle), tappets, pushrods and rocker arms. Valve clearance adjustment through adjusting screws located in rocker arms.
- Maintenance-free, automatically vented block-type fuel injection pump and injection timer. Multi-hole fuel injectors, fuel delivery pump and duplex filter.
- Mechanical governor flanged to injection pump.
- Forced-feed lubrication via gear pump. Oil flow proceeds through liquid-cooled heat exchanger (on 6R engine) and fine filter to lubrication points.
- Closed-circuit coolant system with centrifugal pump and thermostat.
  „TE" engine models use a split-circuit coolant system with internal charge air cooling. The system is split up into two sub-circuits:
  – Charge-air coolant circuit (low-temperature circuit)
  – High-temperature circuit
  Thermostatic control of the charge-air coolant flow as a function of engine load determines the air temperature to the cylinders. Compared to external charge air cooling, this coolant system configuration offers the advantage of enhanced low-load operation and eliminates possible hazards from aggressive or contaminated raw water.
- Plate-core heat exchanger using stacked-up plates which isolate engine coolant from raw water, with the two media passing through the unit in an opposed-flow pattern for optimum heat transfer. These lightweight, high-strength, corrosion-resistant titanium plates can be disassembled for individual cleaning. Unlike tubular coolers, the non-welded heat exchanger design minimizes the risk of leakage and, therefore, possible engine damage due to raw water ingress into the engine coolant circuit.

Technical Definition

Engine Ratings

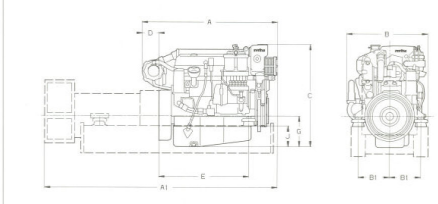
Engine Model	Basis: Mercedes-Benz	Application Groups	Continuous Power kW		Fuel Stop Power kW	
			50 Hz	60 Hz	50 Hz	60 Hz
			1500 rpm	1800 rpm	1500 rpm	1800 rpm
4R 099 AZ51	OM 364	**3A, 3C**	35	40	39	44
6R 099 AZ51	OM 366		54	65	60	72
6R 099 TA51	OM 366A		78	93	86	108
6R 099 TE51	OM 366LA		87	105	96	116

Ratings shown are net brake power (ISO 3046) available at the PTO flange (raw-water pump requirement deducted). Continuous power represents design power for genset drive as per DIN 6280.

Application Groups **3A, 3C:** Marine genset drive

Reference Conditions: Intake air temperature 45 °C
Raw water temperature 32 °C
Barometric pressure 1000 mbar

Version 1A Engine with standard accessory equipment



Dimensions (mm), **Weights** (kg)

Engine Model		4R 099 AZ51	6R 099 AZ51	6R 099 TA51	6R 099 TE51
Version 1A	A	840	1055	1220	1240
	A1 approx.	1750	2000	2100	2100
	B	755	755	755	755
	B1	285	285	285	285
	C	970	930	930	930
	D	–	–	191	191
	E	605	817	817	817
	G	320	286	286	286
	J	225	191	191	191
	Weight	460	580	600	655

Technical Definition

Technical Data

Engine Model			4R 099 AZ51	6R 099 AZ51	6R 099 TA51	6R 099 TE51
General specifications			4-stroke in-line diesel, liquid-cooled, direct injection			
Crankcase			cast iron			
Number of cylinders			4	6	6	6
Bore/stroke		mm	97.5 / 133			
Displacement, cylinder		lit.	0.99			
Displacement, total		lit.	3.97	5.96	5.96	5.96
Valves per cylinder			1 inlet, 1 exhaust			
Direction of rotation			c.c.w. (facing flywheel end)			
Compression ratio			17.25		16.5	
Unassisted cold start		° C	– 20			
Mean piston speed*		m/sec	6.6/8.0	6.6/8.0	6.6/8.0	6.6/8.0
M. E. P.*		bar	7.1/6.7	7.2/7.3	10.5/10.4	11.7/11.7
Oil capacity		lit.	9.5	15.0	15.0	15.0
Coolant capacity incl. recooling system		lit.	18	25	25	27
SFC* (tolerance + 5 %)		(g/kWh)				
	at 100 % power		218/218	211/218	205/211	200/200
	75 % power		218/217	208/215	202/212	201/202
	50 % power		225/230	220/226	210/222	210/212
Oil consumption		(g/kWh)	approx. 0.5 % of fuel consumption (run-in engine)			
Max. permissible air depression at engine/ charger inlet*		mbar	15/20		15/25	
Max. permissible exhaust backpressure at engine/ charger outlet*		mbar	20/25		20/30	
Radiation and convection heat*		kW	4.9/5.7	7.6/9.2	11.1/13.2	12.3/14.9
Coolant heat dissipation*		kW	30.1/34.4	46.5/56.0	67.2/80.1	81.0/101.0
Raw water flow requirement, approx.		m^3/h	2.5/3	4/5	6/7	7/9
Combustion air flow*		$m^3/min.$	3/3.8	3.9/4.7	5.8/7.2	6.6/8.4
Exhaust flow*		$m^3/min.$				
Exhaust temperature after turbine*		° C				
Inclinations relative to waterline:						
(flywheel end down)						
Trim, permanent		∢ °	15	15	15	15
Pitch, temporary (max. 5 min.)		∢ °	45	31	31	31
(flywheel end up)						
Trim, permanent		∢ °	17	13	13	13
Pitch, temporary (max. 5 min.)		∢ °	45	32	32	32
List, permanent		∢ °	40	40	40	40
Roll, temporary (max. 5 min.)		∢ °	45	43	43	43

* at 1500/1800 rpm

Scope of Supply

A. Standard Equipment

1. Marine diesel engine with liquid-cooled exhaust manifold; fuel delivery pump with hand pump; fuel duplex filter with diverter valve and drip pan; BOSCH in-line injection pump with flanged-on BOSCH governor; lube oil pump; lube oil heat exchanger; lube oil filter; coolant pump, coolant thermostat; coolant distribution housing with expansion tank; auxiliary PTO driving the coolant pump, generator and raw water pump.
2. Electric starter (24 V, 4 kW)
3. A.C. generator (28 V, 55 A)
4. Set of dry-type air filters with attaching hardware
5. Companion flanges for exhaust discharge (horizontal)
6. Coolant-to-raw water, plate-core heat exchanger with flame-proof hose lines and self-priming raw water pump
7. Set of engine carriers at aux. PTO end (KGS) and main PTO end (KS)
8. Manual speed fine adjustment
9. Engine shutdown equipment (24 V, 100 % duty cycle)
10. On-engine sensors (24 V, single-pole, non-classifiable)
11. Acceptance test on dynamometer; engine preservation; standard paintwork; installation documentation; operation and maintenance manuals

B. Additional and Alternative Equipment

	Weight kg
1. Jacketed injection lines including leak-off fuel tank with level monitor	+ 3.0
2. Fuel prefilter with connecting hardware and flame-proof hose lines	+ 3.0
3. Oil change hand pump with connecting hardware	+ 3.0
4. Exhaust elbow (swan-neck) with raw water injection, for connection of exhaust hose (instead of A5)	
– above-waterline engine installation	+ 15.0
– below-waterline engine installation	+ 11.0
5. Set of resilient elements for engine carriers (KGS, KS)	+ 7.8
6A. Electronic GAC governor** (instead of mechanical BOSCH governor)	+ 2.0
6B. Electromotive speed fine adjustment (only with electronic GAC governor)	
7. Set of indicators, controls and annunciators for main control stand (24 V, single-pole)	+ 6.1
8. Monitoring system (24 V, 2-pole, classifiable)	
a) On-engine sensors (instead of A10)	+ 4.2
b) Instrumentation and alarms for main control stand (instead of B7) (Individual instruments)	+ 17.2
c) Instrumentation and alarms for main control stand (alternative to b) (Ready-to-install modular type)	+ 20.7
d) Instrumentation for slave control stand	+ 1.4
9. Shipboard spares kit (1 per ship)* a) unrestricted service classification b) small kit (no classification)	
10. Shipboard tool kit (1 per ship)* a) unrestricted service classification b) small kit (no classification)	
11. Engine acceptance test (Classification Society rules)	

\+ Extra weight compared to Standard Equipment
– Reduced weight compared to Standard Equipment

* No general classification rules; complies with Classification Society guidelines.

** Mandatory for paralleled operation

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