



DIESEL
ENGINES MADE IN GERMANY

Diesel engine

6VD 18/16 AL-2

for marine

propulsion

and generator set

Main features:

- output range from 250 to 500 kW
- fuel consumption 190 g/kWh
- operation with heavy oil up to 100 mm²s
- long service life

INNOVATIVE ENGINE TECHNOLOGY



The D110 Diesel engine – “made in Magdeburg” – has for the sake been an established reliability in the international top class engine construction.

In over 60 countries and under variable conditions, D110 Diesel engines are operated as follows:

- Propulsion of ships of the most efficient design
- Power supply on ships
- Stand-by power generating station
- Power generation stations

The development of the new generation of D110 Diesel engines has been aimed at increasing operating costs and environmental protection while continuously maintaining the speed approach.

For reaching the target, further measures such as:

- continuous reduction of fuel consumption and use of modern combustion oils
- reduction of the maintenance requirements and use of improved component safety, automatic monitoring of the operating functions
- reduction of the emission of pollutants

have to be solved by the engine designers.

The engine type D110 W16L, 2 provided by D110 AG, is designed for the output range from 300 to 600 kW and for speeds of 1000 to 1400 rpm and includes a total of a most compact construction. Comprehensive expert team investigations made the engine suitable for variable processes and suitable for many of operation up to 100 miles. Thanks to its low consumption efficiency, low weight, low engine numbers among the low consumption of the engines.

Short description

Type of engine:

4V20 16154L-2

Design:

Four-stroke diesel engine with
water cooling, direct injection,
multi-stage turbocharging
and charge-air cooler

No. of cylinders:

4

Diameter of cylinder:

160 mm

Stroke series:

160 mm

Cylinder speed:

15 000

Rated speed:

1 200 1/p.m.

Medium pressure point:

9 bar

Effective medium pressure:

1.05 MPa

Specific fuel consumption:

190 g/kWh

Consumption of lubricating oil:

0.28 l/h

ISO indicator code:

ISO 3040/1

Lower caloric value = 42,000 kJ/kg without alcohol pumps





1. Housing

The characteristic features of the engine design are the suspended crankshaft bearing and the transverse bearing of the bearing covers in the engine housing. The bearings are mounted on a cast iron housing union. Special attention has been laid on a direct force transmission from the cylinder head screws to the main bearing covers. Deformation of the engine housing and flex of the cylinder liners as well as of the main and connecting rod bearings are minimized thanks to these provisions.

The engine housing consists of cast iron with laminated graphite, the bearing covers are made of cast iron with spherical graphite and the cylinder liners consist of aluminum-silicon with laminated graphite. The oil pans are made of light metal.

2. Crankshaft

The forged crankshaft is supported in oil bearings, three-sided multi-layer slide bearings. Outside the engine housing, a roller-type forced dipper is arranged at the free crankshaft end. Depending on the type of exciter of the engine a 2-bolt dipper may be mounted there for driving a self-priming centrifugal pump or other devices.

The connecting rods are fitted by pin-in-hub four-bearing transmission. In the piston pins, they are provided with a bearing. The connecting rod is supported in exchangeable, three-sided multi-layer bearings. The upper big end bearing bush is designed as a spherical bearing.

The operation with diesel fuel and light heavy oil, light metal pistons are used which are fitted with cast iron ingots for the upper compression ring. Both the compression rings and the oil scraper are chromium-plated. The pistons are cooled by lubricating oil through spray nozzles being arranged in the engine housing lining.



3. Cylinder head and valves drive

The cylinder heads from cast iron with spherical graphite are provided with two inlet and exhaust valves each. These valves are arranged at the rear surfaces. All valves are fitted with pressed-in valve seatings. Each ring is coated with the exhaust valves.

The valves are equipped with timing devices. The injection valve is located in the centre of the cylinder. The cylinder heads are fastened to the engine housing by means of four anti-torque screws each.

The valve drive (actuated by pressure air and oil-based oil-fighting) is effected from the common oil take-off pipe, push-rod, rocking levers and crossmembers.

4. Turbo-charging system

Turbo-charging is carried out by a waste gas turbo-charger of the Axipack charging type. The waste gas turbo-charger is arranged above the flywheel. It is supplied with lubricating oil and cooling-water from the lubrication system of the engine, a compressor-cooling-system and additionally, with fresh air operation, a further cooling device is used for the waste gas turbo-charger.

DESIGN PRINCIPLES



7. Lubricating-oil system

The pressure circulation lubrication system supplies lubricating oil to all bearing points of the engine. The lubricating-oil pump, the oil cooler and the lubricating-oil filter are mounted to the engine. An electric pre-lubricating pump is erected separately for pre-lubricating the engine prior to starting.

8. Operation and monitoring

The attached operating stand is designed for direct operation of the engine and for the connection of an electric remote control. Important operating

parameters of the engine are monitored in connection with a warning/stopping system. In the case of deviating operating conditions, visual and acoustic signals are released or the engine is stopped, respectively.

A hydraulic or electronic governor can be delivered alternatively.

Completion with mechanic or pneumatic remote control is possible.



DIESEL GEAR PLANT

If Diesel engine and gear are erected rigidly, both these units are connected with each other by a highly elastic clutch. The Diesel engine can be erected elastically by using rubber isolators, the connection to the rigidly erected gear is established through a highly elastic double clutch.

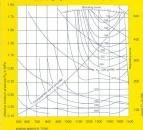
Diesel gear plant – operating data

Nominal speed of the Diesel engine	1,500/1,600 r.p.m.
Nominal output of the Diesel engine	450/540 kW
Nominal output at the gear flange	430/520 kW
Possible reduction	2 to 5

Characteristic diagram 6 VD 1918 AL 2

(kg) = Specific fuel consumption in g/kWh

*Conditions: DIN/ISO 2540/1 – lower specific value
42,750 kJ/kg , engine without oil and water pumps



The Diesel engine and the brushless constant-voltage generator are mounted on one common, flexurally rigid sheet-steel base. Rubber isolators fitted to the base facilitate an elastic erection of the set.

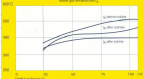
DIESEL – GENERATING SET

Diesel-generating set – operating data

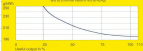
Electric power	600/600 kVA
Generator speed	1,500/1,000 r.p.m.
Power factor cos ϕ	0.8
Frequency	50/60 Hz
Rated voltage for marine operation	390/440 V
Rated voltage for land operation	400/460 V

Characteristic lines of engine at generator operation, engine R 50 18/18 AL-3

Exhaust gas temperature t_{ex}



Specific fuel consumption g_k
(measured without oil and water pumped in
and at a thermal input of 40700 kcal/h)



Operating data of the Diesel engine

Continuous output ^{1) 2)}	450 kW
Rated speed	1.500 r.p.m.
Excessive output ³⁾	495 kW
Overload speed to propeller line	1.548 r.p.m.
Starting speed	100 r.p.m.
Effective medium pressure	1.85 MPa
Final compression pressure at 0% load and rated speed	3.6 MPa MPa
Peak combustion pressure	14.0 MPa

Design data

Number of cylinders	6
Diameter of cylinders	160 mm
Piston stroke	180 mm
Piston displacement of one cylinder	0.62 dm ³
Total piston displacement	3.72 dm ³
Compression ratio	14.0
Control times	
Inlet valve opens ° crank angle:	80.5 before t.d.c. ₁
Inlet valve closes ° crank angle:	25.5 after b.d.c. ₂
Exhaust valve opens ° crank angle:	72.0 before t.d.c. ₁
Exhaust valve closes ° crank angle:	71.0 after t.d.c. ₂
Valve clearance (cold)	0.2 mm for inlet 0.3 mm for exhaust
Ignition sequence	Clockwise rotation: 1-4-2-6-3-5 Anti-clockwise rotation: 1-5-3-6-2-4

Data on charging-air system

Charging pressure ratio	2.85 : 1
Amount of air taken in	3.400 kg/h

Data on waste gas system

Waste gas temperature after cylinder	
Full load	450 °C
Overload	480 °C
Waste gas temperature after turbine	
Full load	400 °C
Overload	400 °C
Waste gas throughput	3.500 kg/h
Waste gas turbidity at full load	≤ 8%
Admissible difference between waste gas temperatures of cylinders	70 K
Admissible waste gas back-pressure at full load	2 kPa

Data on lubricating-oil system

Consumption of lubricating oil		8.35 kg/h
Lubricating-oil pressure before engine		0.5 — 0.6 MPa
Maximum admissible temperature of lubricating oil	Inlet	80 °C
	Outlet	85 °C
Delivery rate of lubrication-oil pump		13 m ³ /h
Oil content of bedplate		160 l

THE 6VD 18/16 AL-2 ENGINE IN FIGURES

Data on fuel system

Specific fuel consumption		196 g/kWh
Delivery rate of fuel pump		1.3 m ³ /h

Data on cooling system

Maximum admissible cooling-water pressure		
Circulation-water circuit		0.4 MPa
Natural-water circuit		0.4 MPa
Maximum admissible cooling-water temperature		
Circulation-water circuit	Inlet	75 °C
	Outlet	80 °C
Natural-water circuit	Inlet	32 °C
	Outlet	44 °C
Delivery rate of circulation-water pump		26 m ³ /h
Delivery rate of natural-water pump		26 m ³ /h
Water content of circulation-water circuit		80 l

Data on starting system

Electric starting system		
Sliding-gear starter 24V		13.3 kW
Starter battery 24 V		2 x 100 Ah
Compressed-air starting system		
Compressed-air starter		25 kW
Starting-air pressure	max.	3.0 MPa
	min.	1.0 MPa

Pollutant emission

At the rated-load point, the following pollutant emission data were measured at a 5 % oxygen content in the waste gas:

$P_{ref} = 450 \text{ kW}$, $n = 1,500 \text{ r.p.m.}$

$\text{NO}_x = 2.76 \text{ g/m}^3$, limit value to TA air: 4.0 g/m^3

$\text{CO} = 0.39 \text{ g/m}^3$, limit value to TA air: 0.65 g/m^3

$\text{CH}_4 = 0.008 \text{ g/m}^3$

Service needs

The data contained in the SKL Manual (B910) "Running materials and protection against corrosion for Diesel engines" are applicable to the engine type 6 VD 18/16 AL-2.

Notes:

¹⁾ According to DIN 5345/51, maximum useful output which the engine can deliver permanently according to its intended use. The output limitation is so adjusted that the engine can still be operated at the excessive output \dot{Q}_{ex} .

²⁾ The above operating data refer to an atmospheric condition with the following parameters:

Atmospheric pressure	100 kPa
Air temperature	25 °C
Relative air humidity	30%
Cooling-water inlet temperature at the charging-air cooler	25 °C

If the conditions at the operating point deviate from the reference condition, the output of the engine must be reduced according to the manufacturer's data.

³⁾ According to DIN 5345/51, maximum useful output which the engine can deliver for a total of one hour without interruptions within a period of 8 hours or with interruptions when alternating with the continuous output \dot{Q}_{ex} .

Weight data

Engine as basic design	2 408 kg
Cylinder block, complete	800 kg
Crankshaft	208 kg
Flywheel	108 kg
Torsional vibration damper	58 kg
Cylinder liner	17 kg
Piston with connecting rod	20.8 kg
Cylinder head	58 kg
Injection pump	87 kg
Oil cooler	43 kg
Waste gas turbo-charger	75 kg
Charging-air cooler	48 kg
Lubricating-oil filter	55 kg

DIMENSIONS AND WEIGHTS

Dimensioned drawing of Diesel-gear plant with elastic erection



Dimensioned drawing of Diesel-generating set 508 kVA



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