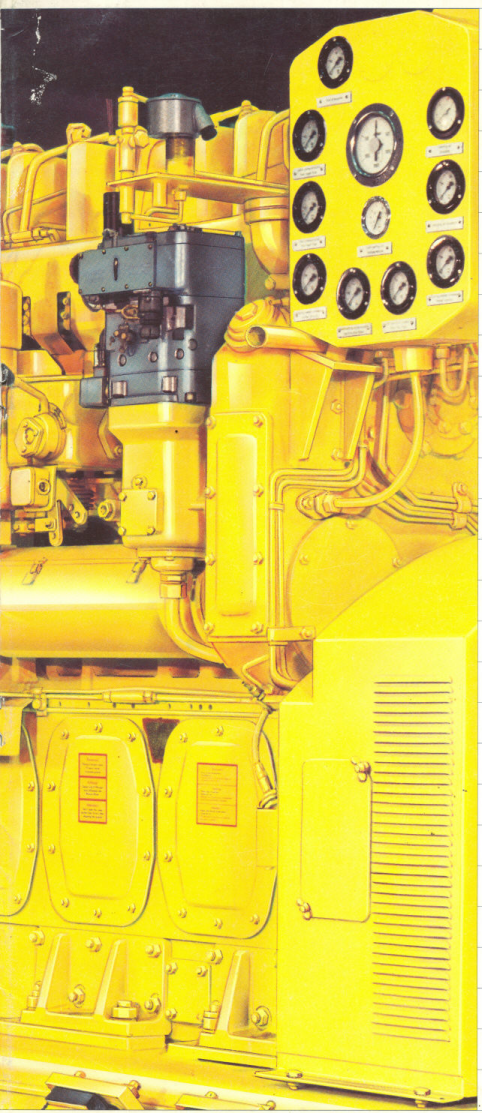


SKL DIESEL

ENGINES MADE IN GERMANY

Engine series

VDS 26/20 AL

for marine

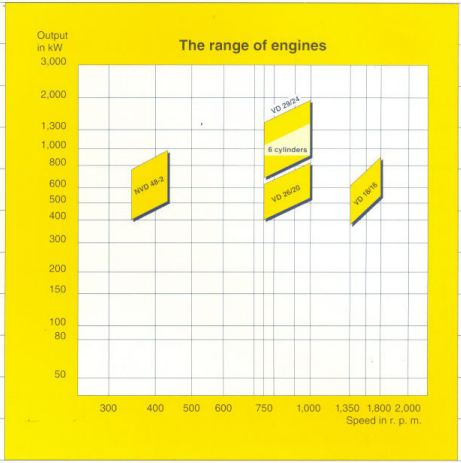
propulsion or

generator set

Main features:

- output range from 530 to 883 kW
- fuel consumption 200 g/kWh
- operation on heavy oils up to 180 mm^2/s
- long service life

Innovative Engine Technology



Based on decades of experience in engine development and manufacture, SKL Diesel engines „Made in Magdeburg" demonstrate high reliability and economy in worldwide operation.

In over 50 countries and under most versatile conditions, SKL Diesel engines are used for the following duties:

- Propulsion of ships
- Power supply on ships
- Stand-by power generating sets
- Diesel power stations

The VDS 26/20 AL engine series has been included in the production range of SKL Magdeburg for many years.

During this time innovative features have continuously been incorporated into the engine design on the basis of the experience gained from the large-scale manufacture and in compliance with the market demands. SKL activities have always been aimed at minimizing operating costs and environmental pollution while simultaneously maximizing the service value.

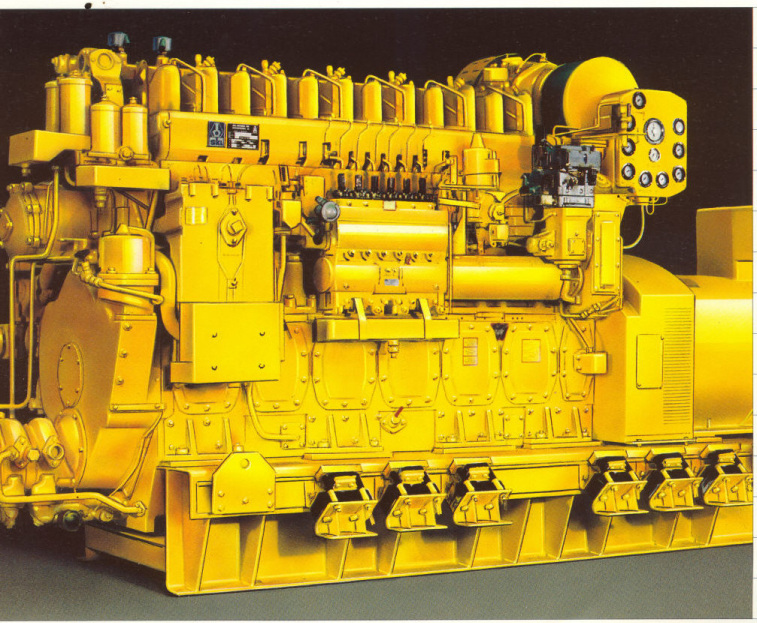
The main objectives of the just finished innovation phase have, therefore, been:

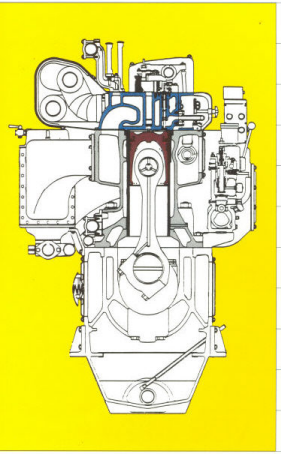
- the further reduction of fuel and lubricant consumption
- heavy-oil suitability up to 180 mm^2/s
- increase of reliability and availability of the engines

Naturally, the interchangeability of the main components and of the basic engine has been maintained so that owners of older engines can also benefit from their improvement.

Short description

Type of engine:	6 VD 26/20 AL-1	6 VD 26/20 AL-2	8 VD 26/20 AL-2
Design:	Four-stroke Diesel engine with water cooling, direct injection of fuel, exhaust turbo-charging with charging-air cooling		
Number of cylinders:	6	6	8
Cylinder diameter:	200 mm	200 mm	200 mm
Piston stroke:	260 mm	260 mm	260 mm
Cylinder output:	88 kW	110 kW	110 kW
Rated speed:	1,000 r.p.m.	1,000 r.p.m.	1,000 r.p.m.
Medium piston speed:	8.67 m/s	8.67 m/s	8.67 m/s
Effective medium pressure:	1.3 MPa	1.62 MPa	1.62 MPa
Heavy-oil suitability:	180 mm^2/s (50°C)	180 mm^2/s (50°C)	180 mm^2/s (50°C)
Specific fuel consumption:	200 g/kWh	200 g/kWh	200 g/kWh
Specific consumption of lubricating oil:	< 1 g/kWh	< 1 g/kWh	< 1 g/kWh





1. Housing

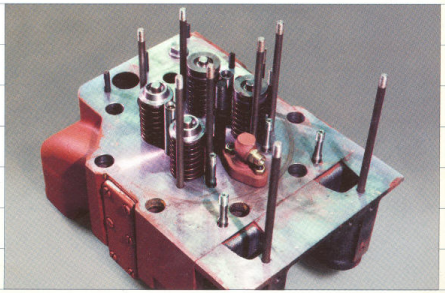
The characteristic feature of the engine design is the raised, flexurally stable bedplate of cast iron, provided with well-ribbed seats for the main bearings of the crankshaft and with laterally screwed-on foot angles for the support on the foundation.

The cylinder block, also of cast iron, is connected with the bedplate by means of necked-down bolts. The cylinder block houses the liners, made of special centrifugal casting, and also serves as a cooling-water jacket. The camshaft bearing bores are fitted with compound bushes.

2. Crank gear

The crankshaft, forged from alloy steel, has unhardened journals and is supported in interchangeable, thin-walled multilayer slide bearings. Inside the engine housing, a low-maintenance viscosity-type torsional vibration damper is arranged at the free crankshaft end. The damper is fitted with inner PTFE bearings for the centrifugal mass. The connecting rod, a forging of alloy steel, is divided transversely at the large connecting-rod eye and, at the partition joint, provided with a high-quality ground toothing with 7 mm pitch. The interchangeable, thin-walled, collar-free, multi-layer slide bearings are secured between the connecting-rod shank and cover by means of four necked-down bolts.

Heat-treated thrust washers are arranged between the connecting-rod cover and the bolt heads. The built piston, with its steel crown and aluminium bottom section, is equipped with three chromium-plated compression rings and one chromium-plated hose-spring tensioned top-chamfered ring. Piston cooling is effected by lubricating oil from the pressure circulating system through the hollow-bored connecting rod.



3. Cylinder head and valve drive

The cylinder head from nodulized-graphite cast iron is provided with two inlet and two exhaust valves, the seat surfaces of which are hard-faced, and with shrunk valve seat rings. Where heavy oil is to be used, the exhaust valves are fitted with turning devices. The injection valve, cooled with heavy-oil operation, is located in the centre of the cylinder head. On the combustion-chamber side, sealing is effected by an 8 mm steel ring packing, which is guided in flat ring grooves in the cylinder-liner collar and in the bottom of the cylinder head. The valve drive (lubricated by pressure oil and enclosed oil-tightly) is operated from the camshaft via roller tappets, push-rods, rockers and cross-members. The strengthened camshaft, supported in compound bushes and divided between the first and the second cylinder, has no locking-ring grooves.

4. Turbo-charging system

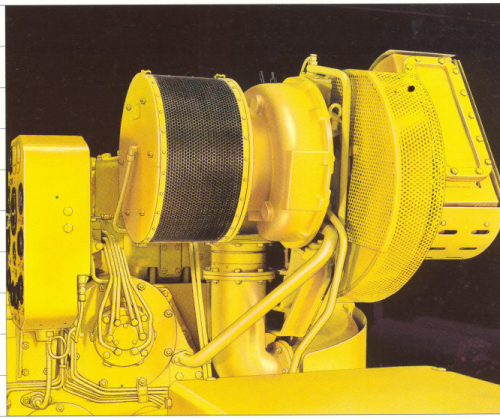
Turbo-charging is carried out by an exhaust turbo-charger (ETC) operating on the pulse system with an efficiency $\geq 64\,\%$. The turbo-charger is connected to the lubricating-oil and cooling-water circuit of the engine. A compressor washing device and additionally, with heavy-oil operation, a turbine washing device is used.

The charging air passes from the compressor to the cylinders through the charging-air cooler, connected to the low-temperature cooling-water circuit, and through the charging-air channel cast integrally with the cylinder block.

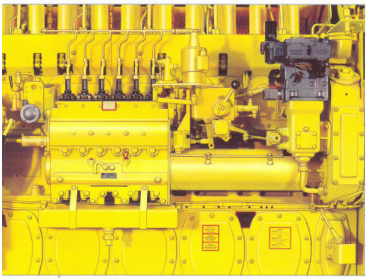
5. Fuel system

On the control side of the engine, the monobloc injection pump is attached. The fuel passes to the injection valves through jacketed pressure pipings. The injection valves are cooled in the case of heavy-oil operation.

DESIGN PRINCIPLES



DESIGN PRINCIPLES



6. Cooling system

The engine is cooled by means of two circuits. In the high-temperature circuit, the cylinder liners, cylinder heads and the exhaust turbo-charger are cooled by means of a heat exchanger.

In the low-temperature circuit, the cooling water flows to the charging-air cooler, oil cooler and heat exchanger. Both circuits are designed for the direct fitting of centrifugal pumps.

7. Lubricating-oil system

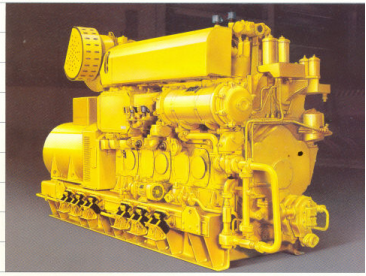
The lubricating-oil circuit designed as a pressure circulation system supplies lubricating oil to all bearing points of the engine by means of the engine-mounted lubricating-oil pump – a double pump is used if the elevated oil tank is erected separately –. The temperature controller (normal control temperature 75°C), lubricating-oil cooler and double filter are included in the lubricating-oil system. Filtering of the lubricating oil is effected by star-folded metal sieve elements featured by long maintenance intervals and easy cleaping. An attached rotary separator additionally filters the lubricating oil in the bypass. Pre-lubrication of the engine prior to starting may be carried out either manually by an attached hand piston pump or, if desired, by an attached electric pre-lubricating pump. If the electric pre-lubricating pump is used for the interval pre-lubrication of emergency sets, it is ensured that the rocker bearings are not supplied with oil when the engine is not running.

8. Operation and monitoring

The attached operator's stand is designed for direct operation of the engine and for the connection of a pneumatic or electric remote control, which, if requested, can be delivered as a packaged unit ready for installation. All important operating parameters are monitored by a warning/stopping system and telemetering equipment. In the case of inadmissible deviations of the operating parameters, visual and acoustic signals are released or the engine is stopped, respectively. Analogue indicators are attached to the engine for local control. A mechanical overspeed protection device is provided to protect the engine.

9. Additional equipment

Provision can be made for a V-belt drive of a separate pump and for the attachment of a starting-air compressor, which can later be switched off.



Operating data

	Unit	6VD26/20AL-1	6VD26/20AL-2	8VD26/20AL-2
Continuous output [1) 2)]	kW	530	662	883
Rated speed	r.p.m.	1,000	1,000	1,000
Excessive output [3)]	kW	583	728	971
Overload speed to propeller curve	r.p.m.	1,032	1,032	1,032
Starting speed	r.p.m.	100	100	100
Effective medium pressure	MPa	1.3	1.62	1.62
Medium piston speed	m/s	8.67	8.67	8.67
Final compression pressure at 0% load and rated speed	MPa	3.4	3.4	3.4
Peak combustion pressure	MPa	13.0	14.7	14.7

Design data

Number of cylinders		6	6	8
Cylinder diameter	mm	200	200	200
Piston stroke	mm	260	260	260
Piston displacement of one cylinder	dm^3	8.17	8.17	8.17
Total piston displacement	dm^3	49.0	49.0	65.3
Compression ratio	–	12.4	12.4	12.4
Control times				
Inlet valve opens		°crank angle		56 before t.d.c.
Inlet valve closes		°crank angle		29 after b.d.c.
Exhaust valve opens		°crank angle		56 before b.d.c.
Exhaust valve closes		°crank angle		49 after t.d.c.
Valve clearance (cold)	mm	0.3	0.3	0.3
Ignition sequence				
– Clockwise rotation		1-3-5-6-4-2		1-3-5-7-8-6-4-2
– Anti-clockwise rotation		1-2-4-6-5-3		1-2-4-6-8-7-5-3

Data on charging-air system

Boost pressure ratio	–	2.20	2.55	2.55
Intake air quantity	m^3/h	3,900	4,400	5,800

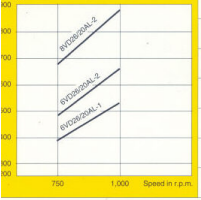
Data on exhaust-gas system

Exhaust temperature after cylinder – full load	°C	340	360	385
– overload	°C	350	375	400
Exhaust temperature after turbine – full load	°C	350	350	375
– overload	°C	350	360	385
Exhaust throughput	kg/h	4,550	5,200	6,850
Exhaust turbidity at full load	%	≤ 5	≤ 5	≤ 5
Admissible difference between exhaust temperatures of cylinders	K	30	30	30
Admissible exhaust back-pressure	mm WC	200	200	200

Output ranges of the basic engine

aking account of speed and medium-pressure variation

P in kW



THE VDS 26/20 AL ENGINE IN FIGURES

Data on lubricating-oil system		Unit	6VD26/20AL-1	6VD26/20AL-2	8VD26/20AL-2
Consumption of lubricating oil		g/kWh	< 1	< 1	< 1
Lubricating-oil pressure before filter	max.	MPa	0.7	0.7	0.7
Delivery rate of lubricating-oil pump		m^3/h	18	18	18
Oil content of bedplate	max.	l	300	300	400
	min.	l	110	110	150

Data on fuel system [4]				
Specific fuel consumption	g/kWh	200	200	200
Delivery rate of fuel pump	m^3/h	0.63	0.63	0.63

Data on cooling system				
Max. admissible cooling-water pressure				
– High-temperature circuit	MPa	0.3	0.3	0.3
– Low-temperature circuit	MPa	0.3	0.3	0.3
Max. admissible cooling-water temperature				
– High-temperature circuit				
– Inlet	°C	82	82	82
– Outlet	°C	88	88	88
– Low-temperature circuit				
– Inlet	°C	32	32	32
– Outlet	°C	42	44	47
Delivery rate of high-temperature water pump	m^3/h	35	35	35
Delivery rate of low-temperature water pump	m^3/h	35	35	35

Data on starting system				
Mean starting-air consumption per starting process	Ncm^3	350	350	350
Starting-air pressure max.	MPa	3.0	3.0	3.0
min.	MPa	1.0	1.0	1.0

Data on warning/stopping system				
Lubricating-oil pressure at engine inlet warning	MPa	0.2	0.2	0.2
stopping	MPa	0.15	0.15	0.15
Outlet water temperature (high-temperature circuit)				
warning	°C	90	90	90
stopping	°C	95	95	95
Controller voltage	V	24	24	24

Marine Diesel Engine

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 anti-vibrators, the connection to the rigidly erected gear is established through a special highly elastic clutch.

Marine Diesel engines (standard outputs)

Output kW	Speed r.p.m.	p_e MPa
530	1,000	1.3
662	1,000	1.62
883	1,000	1.62

Operating time and repair intervals

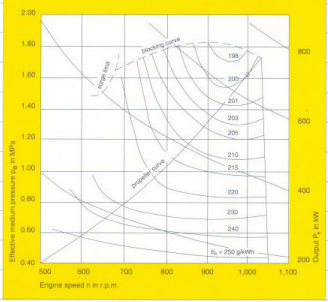
Operating time between general overhauls:	48,000 h
Repair intervals for	
injection valve	3,000 h *
cylinder head	6,000 h *
exhaust turbo-charger (bearings)	20,000 h *
piston rings	20,000 h **
main/big-end bearings	48,000 h **
starting valve	12,000 h **
piston	48,000 h **
cylinder liner	48,000 h **

* check ** exchange

Characteristics of 6VD 26/20 AL-2 engine

specific fuel consumption b_e in g/kWh

(net calorific value = 42,700 kJ/kg; without oil and water pumps fitted)



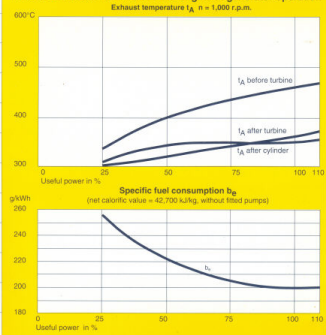
The Diesel engine and the brushless three-phase constant-voltage generator are mounted on one common, flexurally rigid base frame. Anti-vibrators fitted to the base frame facilitate an elastic erection on a ship's or concrete foundation.

DIESEL-GENERATING SET

Diesel-generating sets (continuous power)

Power kVA	Frequency Hz	Speed r.p.m.
600	50	1,000
750/600	50/60	1,000/900
1,000/800	50/60	1,000/900

Characteristics of 6VD 26/20 AL-2 engine at generator operation



Pollutant emission in g/m³ at rated load as referred to a 5 % oxygen content in the exhaust gas (limit values acc. to "TA air")

	6 VD 26/20 AL-1	6 VD 26/20 AL-2	8 VD 26/20 AL-2
NO_x (limit value 4.0)	3.21	3.56	2.65
CO (limit value 0.65)	0.45	0.43	0.39

Service media

The data contained in the SKL Manual M 9912 "Running materials and protection against corrosion for Diesel engines" are applicable to the engine type VD 26/20 AL.

Notes

[1] Continuous output according to DIN 6271/1

[2] The mentioned continuous output data refer to the following conditions:

Atmospheric pressure:	100 kPa
Air temperature:	27 °C
Relative humidity of air:	60 %
Cooling-water inlet temperature at the charging-air cooler:	32 °C

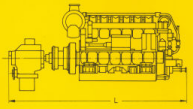
[3] Excessive output according to DIN 6271/1, which the engine can deliver within a period of six hours for a total of one hour uninterrupted or alternating with the continuous output.

[4] The fuel consumption refers to standard conditions acc. to DIN 6271/1, to the use of a fuel having a net calorific value of 42,700 kJ/kg and to an engine fitted with lubricating-oil pump.

Weight data	6VD26/20AL	8VD26/20AL
Engine as basic design	7,900 kg	10,300 kg
Cylinder block, complete	1,390 kg	1,575 kg
Crankshaft	771 kg	991 kg
Flywheel	315 kg	485 kg
Torsional vibration damper	172 kg	416 kg
Cylinder liner	45 kg	45 kg
Piston with connecting rod	64 kg	64 kg
Cylinder head	82 kg	82 kg
Injection pump	150 kg	180 kg
Oil cooler	235 kg	340 kg
Exhaust turbo-charger	190 kg	190 kg
Charging-air cooler	181 kg	181 kg
Lubricating-oil filter	122 kg	122 kg

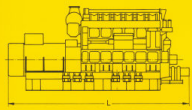
Dimensions And Weights

Diesel-gear set



Power kW	Speed r.p.m.	Length mm	Width mm	Height mm	Weigh kg
530	1,000	4,985	1,440	2,650	11,10
662	1,000	5,085	1,440	2,770	11,10
883	1,000	5,895	1,440	3,060	13,10

Diesel-generating set



Power kVA	Speed r.p.m.	Freq. Hz	Length mm	Width mm	Height mm	Weigh kg
600	1,000	50	4,835	1,736	2,634	12,80
750	1,000	50	4,505	1,736	2,634	13,35
1,000	1,000	50	5,300	1,736	2,634	16,25
675	900	60	4,505	1,736	2,634	13,50
925	900	60	5,300	1,736	2,634	16,50

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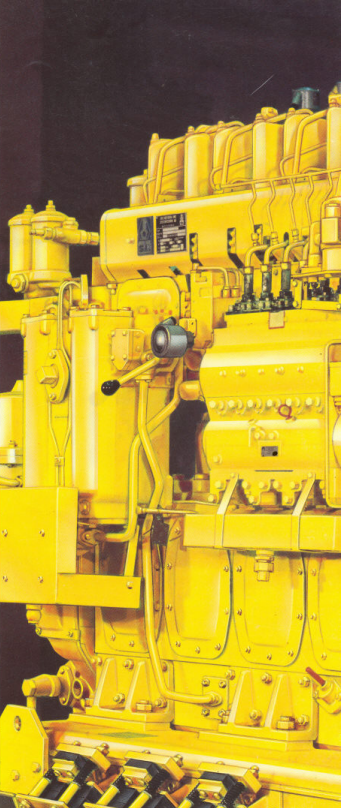

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