



# Operation & Maintenance Manual

**DIESEL ENGINE**

**DL06K Tier4 Interim**



## FOREWORD

This Operation & Maintenance Manual is designed to provide the information on engine operation and maintenance manual to customers and service technicians of the DL06K industrial electronic control diesel engine provided by DOOSAN Infracore.

The DL06K industrial electronic control diesel engine is designed and manufactured to satisfy all requirements, such as low noise, economical power consumption, high-speed, and durability by applying DOOSAN's latest technologies in order to provide the best engine to its customers.

It is important to use precise operation and maintenance procedures to keep the engine in the best possible condition and ensure the best possible long term performance. This Operation & Maintenance Manual provides the specification, defined values, fault diagnosis, parts configuration diagrams, and figures, that allow users to understand, manage, and take actions conveniently and accurately.

Please read this Operation & Maintenance Manual carefully before handling the engine, to ensure that the highest quality maintenance procedures can be applied and the technician's safety can be protected through the use of proper work methods and operating procedures as recommended by DOOSAN Infracore and compiled here within.

We are continually developing and investing in creating products with the best performance and quality, as well as the improvement of maintenance procedures. We are not obliged to reflect all design changes for product improvement in this Operation & Maintenance Manual, and this manual is subject to change without prior notice.

We are always working to satisfy customer requirements and provide more convenient and safe maintenance procedures to its customers.

If you find any incorrect information in this manual or have any inquiry, please contact our head office, dealers or authorized service shops near by your location for any services.

Doosan Infracore Co., Ltd.  
Dec. 2011

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## 0. General Instructions
















This Operation & Maintenance Manual is a manual designed for officially qualified professional service technicians. If maintenance procedures is performed by unqualified personnel, or without the specified tools and facilities, workers or others may be injured or their life can be threatened, or an error may occur that could fatally affect engine performance.

Regular checkups and management are required to keep the engine in optimal condition and performing at its best. If any part needs to be replaced, the genuine part supplied by DOOSAN Infracore and specified in the Parts Book should be used. Use of uncertified, similar parts, or recycled parts may cause serious damage to the engine. If such a part is used, DOOSAN Infracore will bear no responsibility.

Please note that the work procedures described in this Operation & Maintenance Manual are the safest and most efficient work procedures, and you may be required to use special tools for some work items.

Please contact us for genuine parts and special tools.

This Operation & Maintenance Manual uses the following symbols to explain maintenance procedures, so that workers can make preparations and understand work items in advance.

	Removal		Adjustment
	Installation		Cleaning
	Disassembly		Pay close attention-Important
	Reassembly		Tighten to specified torque
	Align the marks		Use special tools of manufacturer's
	Directional Indication		Lubricate with oil
	Inspection		Lubricate with grease
	Measurement		

Please follow the instructions listed below to prevent environmental pollution during engine maintenance.

- Take old oil to an old oil disposal point only.
- Ensure without fail that oil and diesel fuel will not get into the sea or rivers and canals or the ground.
- Treat undiluted anti-corrosion agents, antifreeze agents, filter element and cartridges as special waste.
- The regulations of the relevant local authorities are to be observed for the disposal of spent coolants and special waste.





# 1. Safety Regulations & Specifications

## 1.1. Safety Regulations

### 1.1.1. General notes

- You should read this manual carefully and follow routine and regular check methods to use the engine as safely as possible and minimize problems.
- Safety rules can be divided into three parts - injury to people, damage to property, and pollution. In addition, users must comply with the regulations which apply to each particular engine model, and the regulations regarding its place of use.



#### **IMPORTANT :**

**If despite all precautions, an accident occurs, in particular through contact with caustic acids, fuel penetrating the skin, scalding from oil, antifreeze being splashed in the eyes etc, consult a doctor immediately.**

### 1.1.2. To prevent accidents with injury to persons

#### 1) Engine starting and operation

- Please read "Caution" in the manual carefully before starting an engine. If you don't understand anything, please contact Doosan Infracore.
- Please attach the "Authorized personnel only" warning sign on the engine for safety, and remind the engine driver that the driver is responsible for safety in the engine room.
- Only authorized personnel should start and run the engine. Unauthorized personnel should not start the engine.
- Do not access the engine parts when the engine is running.
- Do not touch the engine with bare hands while the engine is running, because the engine is hot and dangerous.
- Exhaust fumes are toxic. Check ventilation when the engine is running in an enclosed space.

#### 2) Maintenance and care

- The engine must be stopped before performing maintenance procedures. If the engine should be maintained during operation, please take additional caution as to the danger of burns or accidents. Refrain from doing maintenance when the engine is running as much as possible. Do not get too close to rotating parts, if maintenance works are inevitable during operation.
- Replace engine oil when it is hot after operation, when the engine is stopped.



#### **CAUTION :**

**Do not replace or disassemble pipes or hoses (engine fuel circuit, engine oil circuit, coolant circuit, and compressed air circuit) while the engine is running. Fluid spattering may cause injury.**

- Check the amount of oil in the oil pan, and use a container large enough to hold engine oil when replacing it.
- When replacing or replenishing engine coolant, cool down the engine and disassemble the drain plug. The heated coolant may cause burns and safety accident.

- Do not fasten or open pipes or hoses (engine oil circuit, coolant circuit, and compressed air circuit) while the engine is running. Fluid spattering may cause injury.
- Fuel is a highly combustible substance. Do not smoke or use fire around the engine. Refuel the engine only when the engine is stopped.
- Do not mix engine maintenance materials (coolant, engine oil, fuel, battery fluid, etc.) with drinking water containers.
- Follow the instructions of the manufacturer when checking or handling the battery



**CAUTION :**

**Battery fluid is toxic, corrosive, and explosive. Therefore, the battery should be handled by a specialized technician only.**

**3) When carrying out checking, setting and repair work**

- Engine maintenance should be performed by authorized personnel only.
- Only tools suitable for the purpose should be used. If a wrench with a worn-out edge is used, safety accidents may occur due to sliding.
- When an engine is lifted by a crane, nobody should stand below it, or pass by it. Please check the safety conditions of the crane first.
- For electric welding, turn off the engine, block the power supply, and remove the vehicle side wire harness connector that is connected to the ECU (electronic control unit).
- Never weld the electric device or ECU, or apply electric or mechanical shock.  
Disconnect the battery ground wire first when working with electric devices. Connect the ground wire again when other work is completed, in order to prevent a short circuit.

**1.1.3. To prevent damage to engine and premature wear**

- 1) Do not use the engine any purpose other than original design.

For more details, please refer to reference data from sales. Never calibrate the ECU without the approval of DOOSAN.

- 2) If any fault is found in the engine, the cause should be found and fixed immediately to prevent serious damages to the engine.

- 3) Please use genuine spare and maintenance parts recommended by DOOSAN.

DOOSAN will bear no responsibility for damage due to the use of unauthorized parts.

- 4) Keep the following points in mind, in addition to the above instructions.

- Use normal and clean diesel fuel only. Do not use bio-diesel. Please refer to the recommendations on fuel. Diesel fuel should not contain any moisture
- Do not run the engine without lubricant and coolant. Use the service products (engine oil, coolant, and anticorrosion agent) recommended by DOOSAN only.
- Keep the surroundings of the engine clean.
- Refer to the recommendations about fuel in the handling manual.
- Maintain the engine at a regular interval, using the engine checklist.
- Do not stop the engine abruptly if the engine is hot. Instead, run the engine in the idle state for 5 minutes without load to reduce engine temperature.
- Do not refill the coolant if the engine is overheated.

- Do not refill engine oil to a level higher than those marked on the level gauge. Keep the maximum allowable slant of the engine during maintenance works.
- Check whether equipment gauges (battery, oil pressure, coolant temperature) work properly (normally).
- Do not run the engine without coolant. If coolant freezing is expected in winter, drain off coolant.

#### 1.1.4. To prevent pollution

##### 1) Engine oil filter elements, fuel filters

- Pour used oil into the oil collection drum.
- Pay special attention not to spill oil on the ground or into the ocean. Leaked oil can pollute sources of drinking water.
- Separate oil and oil filter cartridge as wastes of environmental pollution, and dispose them according to the prescribed regulations.

##### 2) Coolant

- Treat non-diluted anticorrosive agents and coolants as dangerous waste.
- Comply with the relevant regulations of the related government office, when disposing used coolant.

#### 1.1.5. Notes on safety in handling used engine oil

If the skin is in contact with engine oil repetitively or for a long period of time, the skin can contract or gets dry, and become inflamed.

As used engine oil contains hazardous substances, follow basic safety rules at the work site when handling engine oil.



##### < Cautions for your health >

- Do not touch used engine oil repetitively or for a long time.
- Apply skin protection cream or wear gloves.
- Clean the skin if contacted with engine oil.
- Use soap and water when washing your skin.
- Do not use gasoline, diesel fuel, thinner, or solvent as an abstergent.
- Apply an oily cream to your skin after washing your skin.
- Replace your clothes or shoes if they have been soaked with oil.
- Do not put oil-stained rags into your pocket.



##### **CAUTION :**

**Please check whether used engine oil is processed properly.  
Wrongly processed engine oil can contaminate drinking water.**

Therefore, do not pour out engine oil on the ground, waterway, drain, or sewer. You may be punished if you don't obey these handling regulations. Be careful when disposing engine oil. Please contact the seller, supplier, or related agency, regarding engine oil collection methods.

### 1.1.6. General repair instructions



1. Disconnect the battery ground wire first for maintenance, in order to prevent wire damage due to a short circuit.
2. Use the cover not to damage or pollute disassembled parts.
3. Handle engine oil and coolant with care, as they can do damage to paintings.
4. It is recommended to use the proper tools and special tools for maintenance of the specified parts, considering efficiency and reliability of the maintenance work.
5. Make sure to use the genuine Doosan Infracore replacement parts.
6. Use the new cotter pin, gasket, O-ring, sealing, oil seal, lock washer, and self lock nut when maintaining these parts. If you use the existing parts without change, normal function cannot be maintained.
7. Keep disassembled parts by group for smooth reassembly. In particular, bolts and nuts with different strength and shape are used, depending on the assembly position. Therefore, you should separate bolts and nuts clearly.
8. Clean all parts before inspection or re-assembly. In addition, clean the oil hole using compressed air to prevent the presence of foreign objects.
9. Spray oil or grease on the rotation or sliding part thinly before assembly.
10. If necessary, apply adhesives to the gasket to prevent an oil or water leak.
11. Assemble parts, using pre-defined bolts and net fastening torque.
12. Please check the engine again, when maintenance is completed.
13. Check common rail pressures and engine temperature using the laptop diagnosis device before working with fuel lines, and start work 5 minutes after the engine has stopped.

## 1.2. Engine Specifications

Items	Engine model		DL06K	
			LDE00/LDE03/LDE06	LDE01/LDE02/LDE04
Engine type	Water-cooled, 4 cycle, In-line, Turbo charged & inter-cooled			
Combustion chamber type	Direct injection type			
Cylinder liner type	Replaceable dry liner			
Timing gear system	Gear driving type			
No. of piston rings	2 compression ring, 1 oil ring			
No. of cylinders – bore x stroke	(mm)	6 – 100 x125		
Total piston displacement	(cc)	5,890		
Compression ratio	17.5 : 1			
Engine Dimension (length x width x height)	(mm)	1,264 X 848 X 1,174	1,264 X 848 X 1,124	
Weight	(kg)	645	644	
Rotating direction (from flywheel)	Counterclockwise			
Firing order	1 – 5 – 3 – 6 – 2 – 4			
Fuel high pressure pump type	Bosch CP3.3 high pressure fuel pump type			
Engine control type	Electric control type (ECU)			
Injector type	Multiple hole type			
Fuel injection pressure	(bar)	250bar (operating pressure 1,800 bar)		
Valve clearance (cold) (mm)	Intake valve	0.3		
	Exhaust valve	0.4		
Intake valve	Open at	21° (B.T.D.C)		
	Close at	33° (A.B.D.C)		
Exhaust valve	Open at	52.6° (B.B.D.C)		
	Close at	22.2° (A.T.D.C)		
Fuel filter type	Current type (cartridge type)			
Oil pressure (kg/cm <sup>2</sup> )	At idle speed	1.5 or more		
	At rated speed	3.0 ~ 5.5		
Using lubrication oil	SAE 15W40 (over API CJ-4 or ACEA-E9 class)			
Lubrication method	Full forced pressure feed type			
Oil pump type	Gear type driven by crankshaft			
Oil filter type	Cartridge type			
Lubricating oil capacity (Max/min) <sup>1)</sup>	(lit)	27 / 17	22 / 16	
Oil cooler type	Water cooled			
Oil pressure indicator	Hydraulic indicator			
Water pump	Belt-driven centrifugal type			
Cooling method	Pressurized circulation			
Oil separator	OCV			
Cooling water capacity (engine only)	(lit)	13		

<sup>1)</sup> With 2.0 liters in the engine

Items		Engine model	DL06K	
			LDE00/LDE03/LDE06	LDE01/LDE02/LDE04
Thermostat	Type	Wax pallet type		
	Open at (°C)	75		
	Open wide at (°C)	90		
	Valve lift (mm)	9.5		
Water temperature indicator		Water temperature sensor mounted		
Turbo charger		Exhaust gas driven type (WGT)		
Engine stop system		Fuel feeding shut-off by ECU		
Alternator (voltage - capacity) (V -A)		24 – 80, 24 – 120, 24 – 150		
Starting motor (voltage - output) (V -kW)		24 – 6.0		
Air heater (V -kW)		24 – 2.1		

### 1.3. Engine Power

tolerance : ±5 %

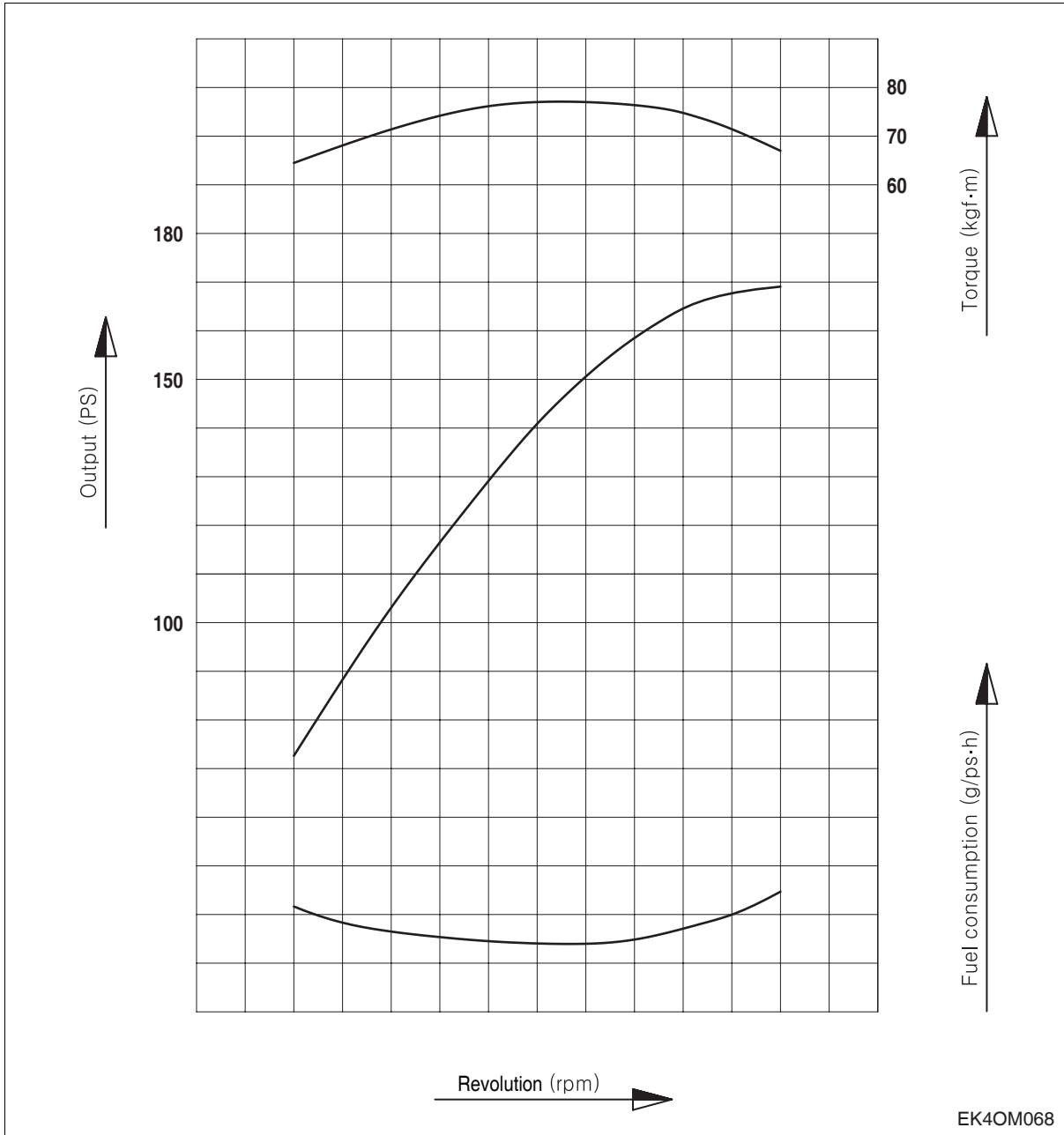
Engine model		Performance <sup>1)</sup>			
Model	Suffix	Power (PS / rpm)	Torque (kg·m / rpm)	Low idle (rpm)	High idle (rpm)
DL06K	LDE00	169 / 1,800	77 / 1,400	800 ± 15	1,900 ± 25
	LDE01	111 / 1,850	49 / 1,400	800 ± 15	1,950 ± 25
	LDE02	127 / 1,950	54 / 1,400	800 ± 15	2,050 ± 25
	LDE03	188 / 1,900	82 / 1,400	800 ± 15	2,000 ± 25
	LDE04	139 / 2,000	60 / 1,400	800 ± 15	2,080 ± 25
	LDE05	154 / 2,000	66 / 1,400	800 ± 15	2,100 ± 25
	LDE06	176 / 1,900	77 / 1,400	800 ± 15	2,000 ± 25

Note1) : All data are based on operation without cooling fan.

## 1.4. Engine Performance Curve

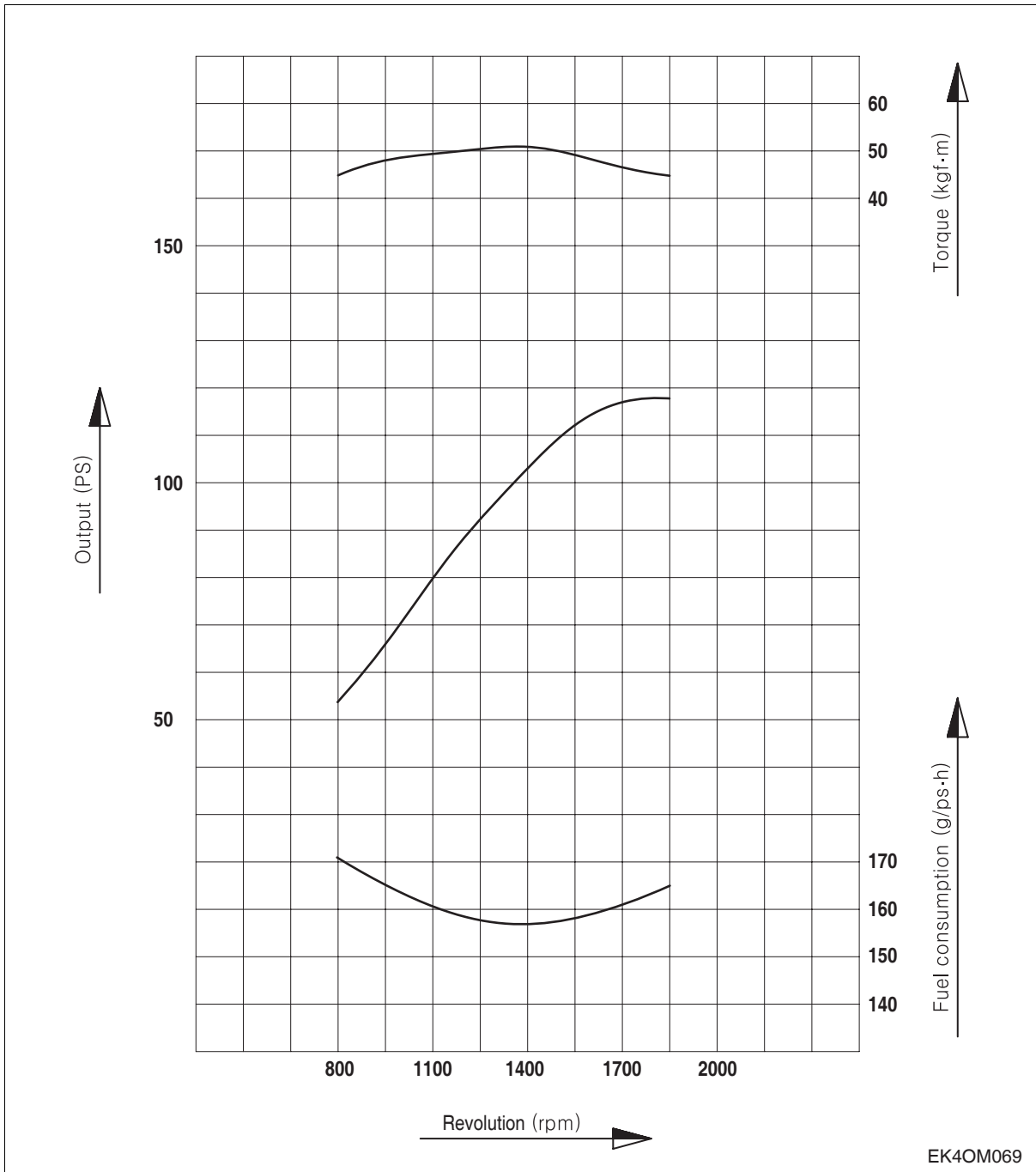
### 1.4.1. Performance curve

- DL06 – LDE00



Performance		KS-R1004
Output	(rating)	169 PS / 1,800 rpm
Torque	(max.)	77 kgf·m / 1,400 rpm

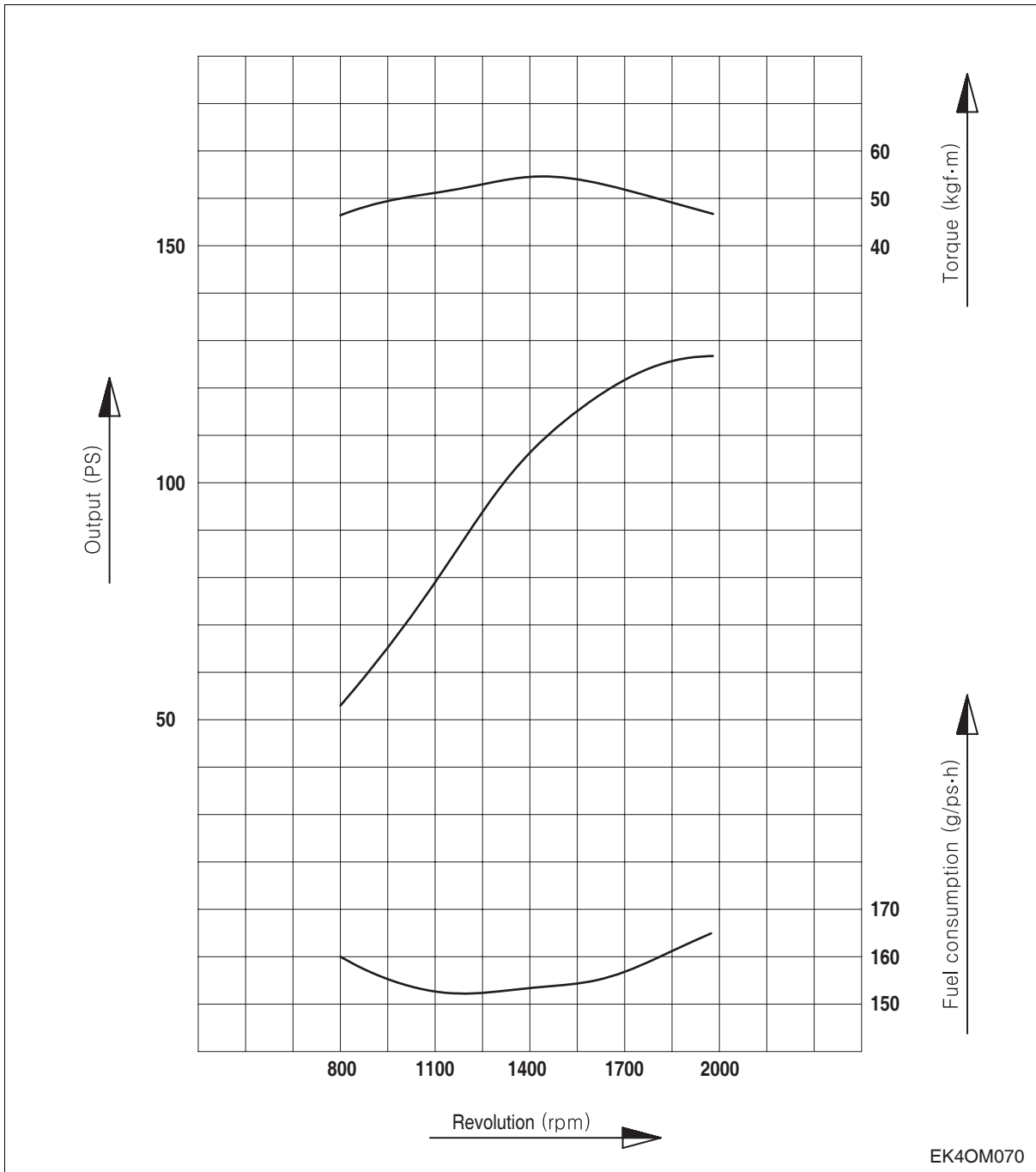
● DL06-LDE01



Performance		KS-R1004
Output	(rating)	111 PS / 1,850 rpm
Torque	(max.)	49 kgf·m / 1,400 rpm

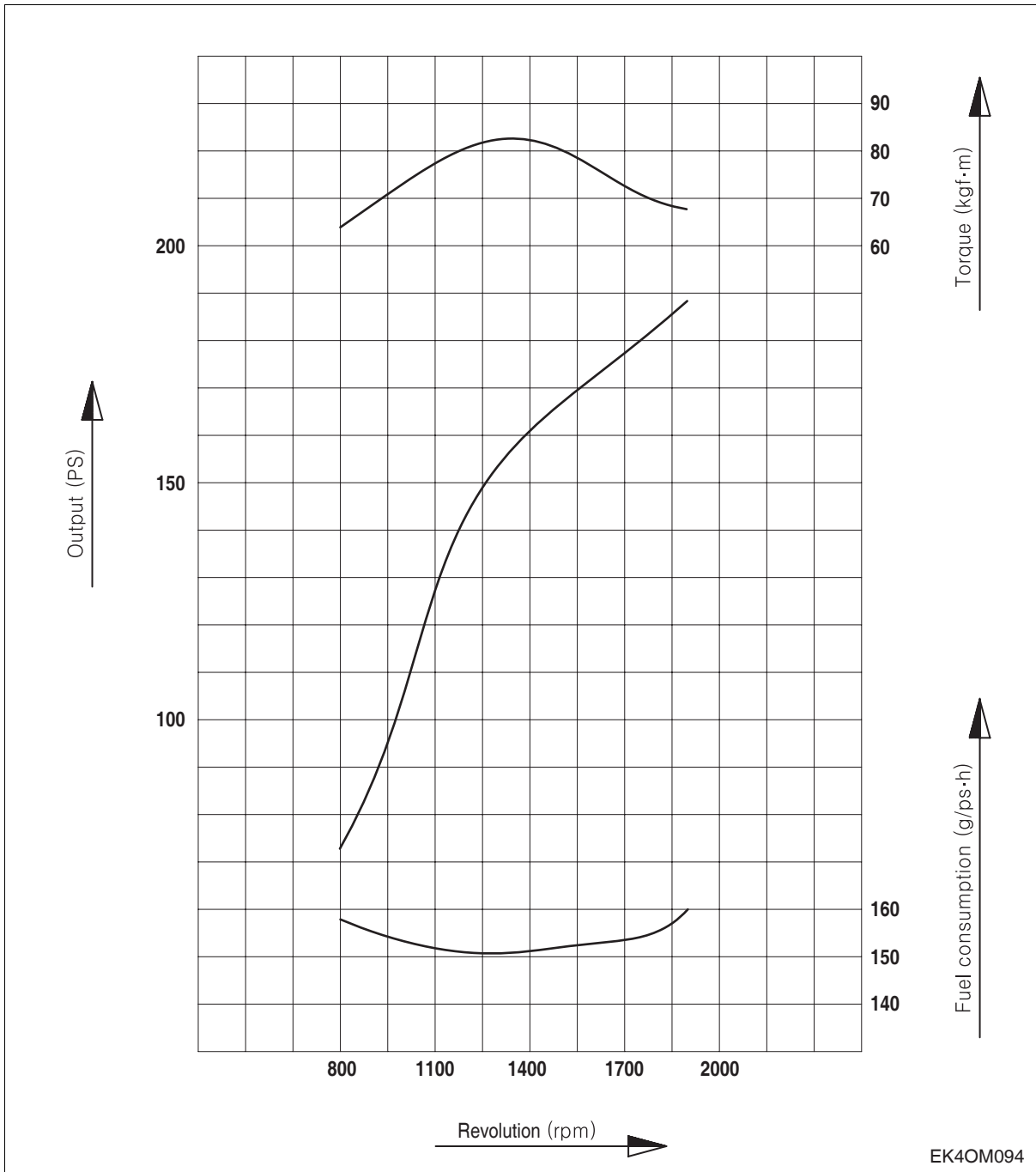


● DL06-LDE02



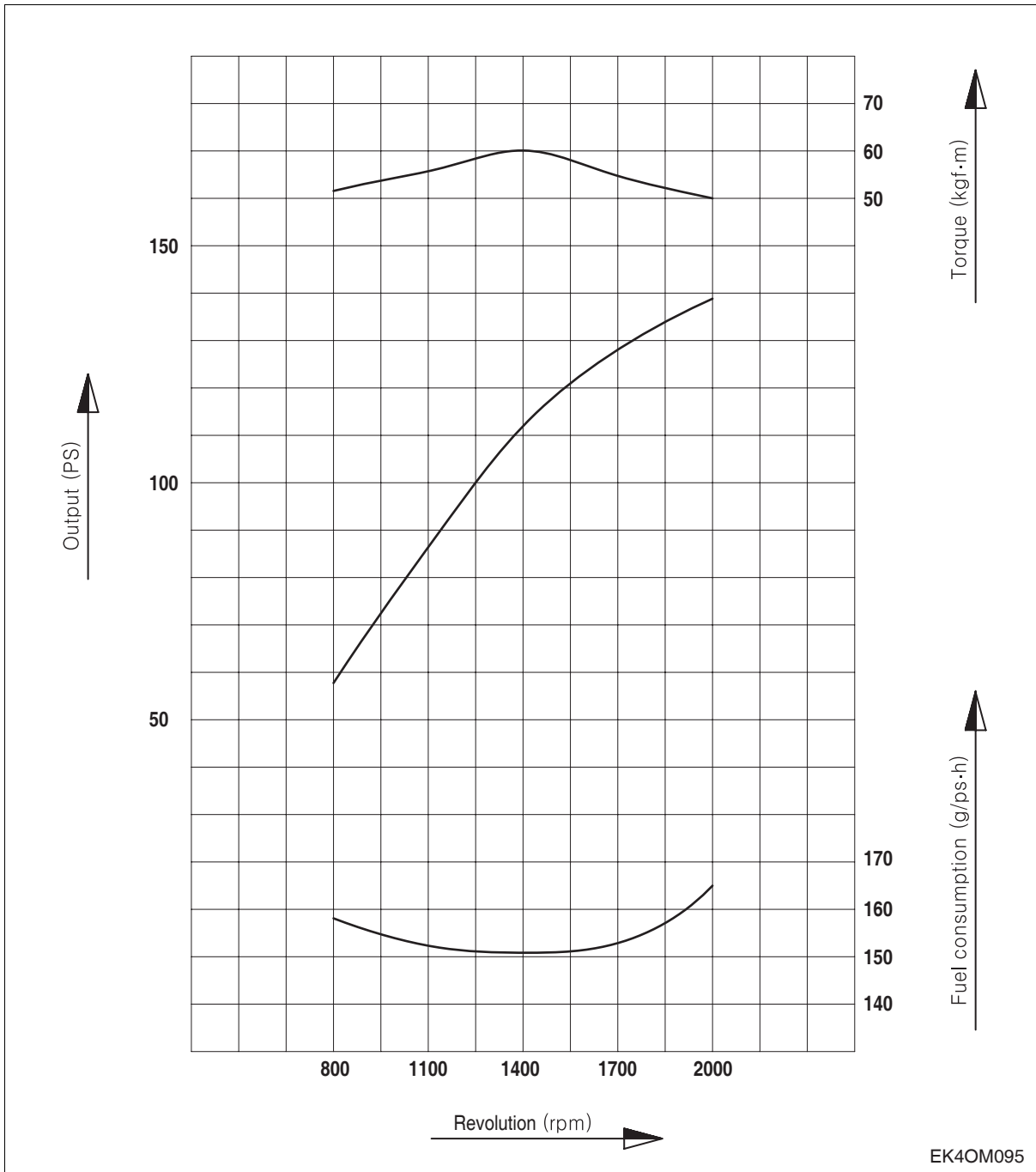
Performance		KS-R1004
Output	(rating)	127 PS / 1,950 rpm
Torque	(max.)	54 kgf.m / 1,400 rpm

● DL06-LDE03



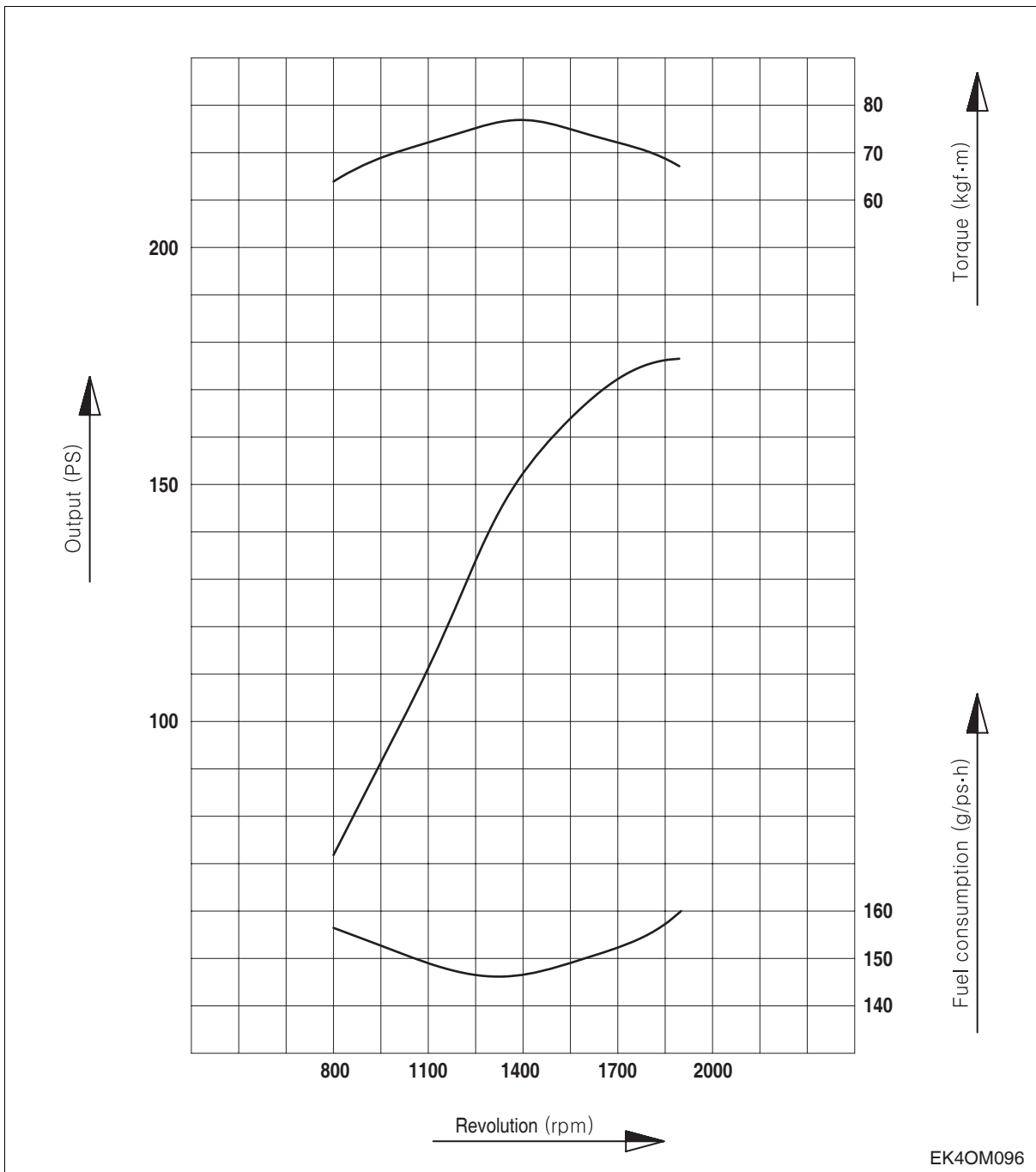
Performance		KS-R1004
Output	(rating)	188 PS / 1,900 rpm
Torque	(max.)	82 kgf·m / 1,400 rpm

● DL06-LDE04



Performance		KS-R1004
Output	(rating)	139 PS / 2,000 rpm
Torque	(max.)	60 kgf·m / 1,400 rpm

● DL06-LDE06



EK40M096

Performance		KS-R1004
Output	(rating)	176 PS / 1,900 rpm
Torque	(max.)	77 kgf·m / 1,400 rpm