

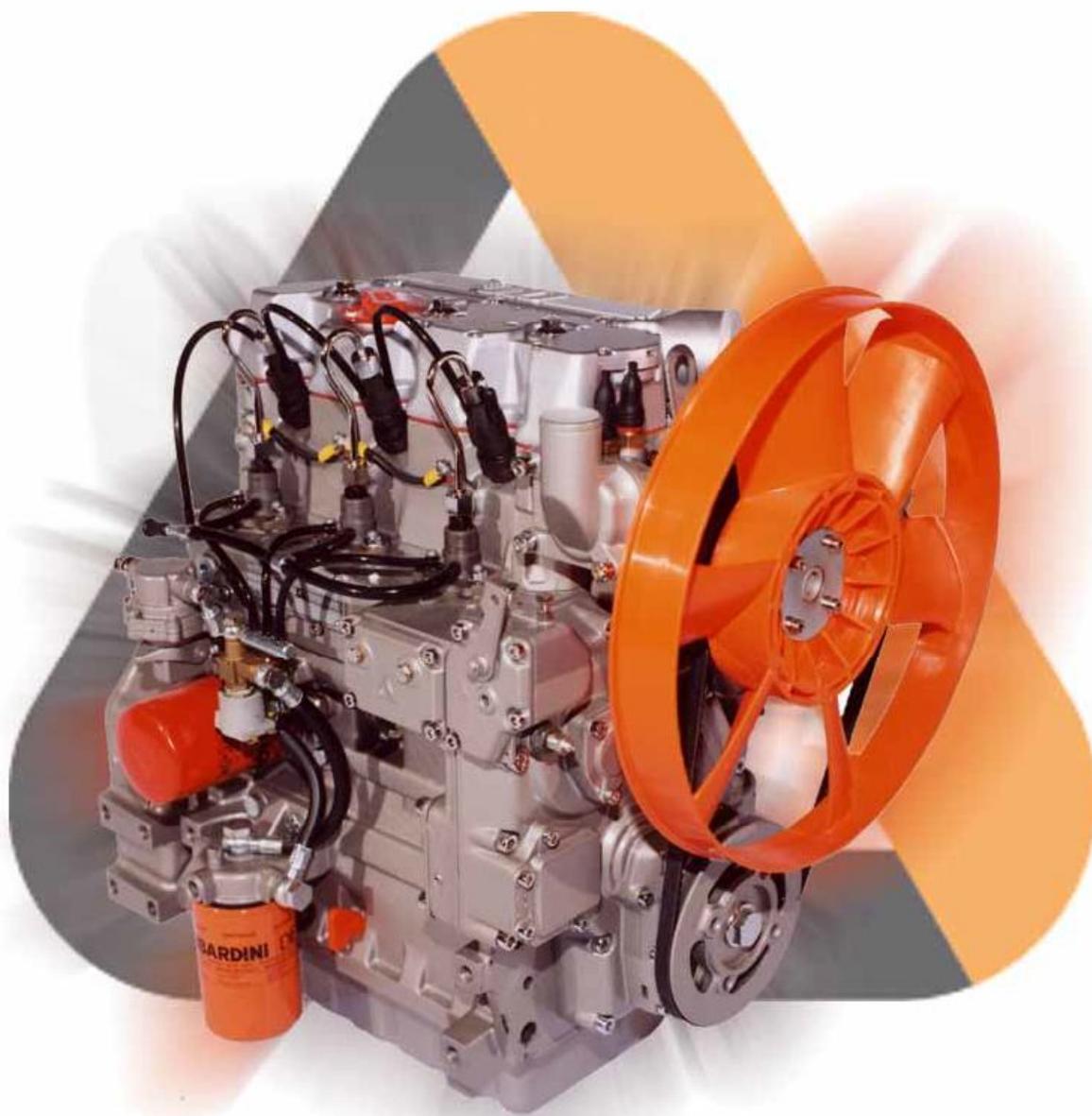
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WORKSHOP MANUAL

CHD series Engine

cod. 1-5302-345

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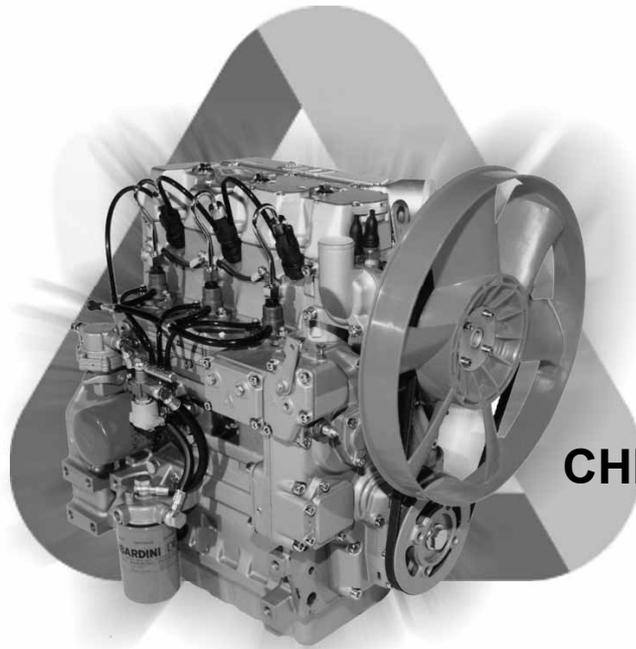


LOMBARDINI SERVICE

A KOHLER COMPANY

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CHD Engine Series

PREFACE

- Every attempt has been made to present within this service manual, accurate and up to date technical information. However, development on the **LOMBARDINI** series is continuous. Therefore, the information within this manual is subject to change without notice and without obligation.
- The information contained within this service manual is the sole property of **LOMBARDINI**. As such, no reproduction or replication in whole or part is allowed without the express written permission of **LOMBARDINI**.

Information presented within this manual assumes the following:

- 1 - The person or people performing service work on **LOMBARDINI** series engines is properly trained and equipped to safely and professionally perform the subject operation;
 - 2 - The person or people performing service work on **LOMBARDINI** series engines possesses adequate hand and **LOMBARDINI** special tools to safely and professionally perform the subject service operation;
 - 3 - The person or people performing service work on **LOMBARDINI** series engines has read the pertinent information regarding the subject service operations and fully understands the operation at hand.
- This manual was written by the manufacturer to provide technical and operating information to authorised **LOMBARDINI** after-sales service centres to carry out assembly, disassembly, overhauling, replacement and tuning operations.
 - As well as employing good operating techniques and observing the right timing for operations, operators must read the information very carefully and comply with it scrupulously.
 - Time spent reading this information will help to prevent health and safety risks and financial damage. Written information is accompanied by illustrations in order to facilitate your understanding of every step of the operating phases.



REGISTRATION OF MODIFICATIONS TO THE DOCUMENT

Any modifications to this document must be registered by the drafting body, by completing the following table.

Drafting body	Document code	Model N°	Edition	Revision	Issue date	Review date	Endorsed
CUSE/ATLO <i>M. Primelli</i>	1-5302-345	50534	6°	5	31-12-89	01-12-2009	<i>[Signature]</i>

This manual gives the main instructions on how to repair LOMBARDINI diesel engines **LDW 1503 - 1603 - 2004 - 2004/T - 2204 - 2204/T**, fluid cooling circuit, updates as of December 1st 2009.

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WARRANTY CERTIFICATE

- The products manufactured by Lombardini Srl are warranted to be free from conformity defects for a period of 24 months from the date of delivery to the first end user.
- For engines fitted to stationary equipment, working at constant load and at constant and/or slightly variable speed within the setting limits, the warranty covers a period up to a limit of 2000 working hours, if the above mentioned period (24 months) is not expired.
- If no hour-meter is fitted, 12 working hours per calendar day will be considered.
- For what concerns the parts subject to wear and deterioration (injection/feeding system, electrical system, cooling system, sealing parts, non-metallic pipes, belts) warranty covers a maximum limit of 2000 working hours, if the above mentioned period (24 months) is not expired.
- For correct maintenance and replacement of these parts, it is necessary to follow the instructions reported in the documentation supplied with each engine.
- To ensure the engine warranty is valid, the engine installation, considering the product technical features, must be carried out by qualified personnel only.
- The list of the Lombardini authorized dealers is reported in the "Service" booklet, supplied with each engine.
- Special applications involving considerable modifications to the cooling/lubricating system (for ex.: dry oil sump), filtering system, turbo-charged models, will require special written warranty agreements.
- Within the above stated periods Lombardini Srl directly or through its authorized network will repair and/or replace free of charge any own part or component that, upon examination by Lombardini or by an authorized Lombardini agent, is found to be defective in conformity, workmanship or materials.
- Any other responsibility/obligation for different expenses, damages and direct/indirect losses deriving from the engine use or from both the total or partial impossibility of use, is excluded.
- The repair or replacement of any component will not extend or renew the warranty period.

Lombardini warranty obligations here above described will be cancelled if:

- Lombardini engines are not correctly installed and as a consequence the correct functional parameters are not respected and altered.
 - Lombardini engines are not used according to the instructions reported in the "Use and Maintenance" booklet supplied with each engine.
 - Any seal affixed to the engine by Lombardini has been tampered with or removed.
 - Spare parts used are not original Lombardini.
 - Feeding and injection systems are damaged by unauthorized or poor quality fuel types.
 - Electrical system failure is due to components, connected to this system, which are not supplied or installed by Lombardini.
 - Engines have been disassembled, repaired or altered by any part other than an authorized Lombardini agent.
- Following expiration of the above stated warranty periods and working hours, Lombardini will have no further responsibility for warranty and will consider its here above mentioned obligations for warranty complete.
- Any warranty request related to a non-conformity of the product must be addressed to the Lombardini Srl service agents.

GENERAL SERVICE MANUAL NOTES

- 1 - Use only genuine Lombardini repair parts.
Failure to use genuine Lombardini parts could result in sub-standard performance and low longevity.
- 2 - All data presented are in metric format. That is,

dimensions are presented in millimeters (mm), torque is presented in Newton-meters (Nm), weight is presented in kilograms (Kg), volume is presented in liters or cubic centimeters (cc) and pressure is presented in barometric units (bar).

GLOSSARY AND TERMINOLOGY

For clarity, here are the definitions of a number of terms used recurrently in the manual.

- **Cylinder number one:** is the piston timing belt side «viewed from the flywheel side of the engine».
- **Rotation direction:** anticlockwise «viewed from the flywheel side of the engine».

SAFETY AND WARNING DECALS

- Important remarks and features of the text are highlighted using symbols, which are explained below:



Danger – Attention

This indicates situations of grave danger which, if ignored, may seriously threaten the health and safety of individuals.



Caution – Warning

This indicates that it is necessary to take proper precautions to prevent any risk to the health and safety of individuals and avoid financial damage.



Important

This indicates particularly important technical information that should not be ignored.

SAFETY REGULATIONS

- **LOMBARDINI** Engines are built to supply their performances in a safe and long-lasting way.
To obtain these results, it is essential for users to comply with the servicing instructions given in the relative manual along with the safety recommendations listed below.
- The engine has been made according to a machine manufacturer's specifications and all actions required to meet the essential safety and health safeguarding requisites have been taken, as prescribed by the current laws in merit.
All uses of the engine beyond those specifically established cannot therefore be considered as conforming to the use defined by **LOMBARDINI** which thus declines all liability for any accidents deriving from such operations.
- The following indications are dedicated to the user of the machine in order to reduce or eliminate risks concerning engine operation in particular, along with the relative routine maintenance work.
- The user must read these instructions carefully and become familiar with the operations described.
Failure to do this could lead to serious danger for his personal safety and health and that of any persons who may be in the vicinity of the machine.
- The engine may only be used or assembled on a machine by technicians who are adequately trained about its operation and the deriving dangers.
This condition is also essential when it comes to routine and, above all, extraordinary maintenance operations which, in the latter case, must only be carried out by persons specifically trained by **LOMBARDINI** and who work in compliance with the existing documentation.
- Variations to the functional parameters of the engine, adjustments to the fuel flow rate and rotation speed, removal of seals, demounting and refitting of parts not described in the operation and maintenance manual by unauthorized personnel shall relieve **LOMBARDINI** from all and every liability for deriving accidents or for failure to comply with the laws in merit.
- On starting, make sure that the engine is as horizontal as possible, unless the machine specifications differ.
In the case of manual start-ups, make sure that the relative actions can take place without the risk of hitting walls or dangerous objects, also considering the movements made by the operator.
Pull-starting with a free cord (thus excluding self-winding starting only), is not permitted even in an emergency.
- Make sure that the machine is stable to prevent the risk of overturning.
- Become familiar with how to adjust the rotation speed and stop the engine.
- Never start the engine in a closed place or where there is insufficient ventilation.
Combustion creates carbon monoxide, an odourless and highly poisonous gas.
Lengthy stays in places where the engine freely exhausts this gas can lead to unconsciousness and death.
- The engine must not operate in places containing inflammable materials, in explosive atmospheres, where there is dust that can easily catch fire unless specific, adequate and clearly indicated precautions have been taken and have been certified for the machine.
- To prevent fire hazards, always keep the machine at least one meter from buildings or from other machinery.
- Children and animals must be kept at a due distance from operating machines in order to prevent hazards deriving from their operation.
- Fuel is inflammable. The tank must only be filled when the engine is off.
Thoroughly dry any spilt fuel and move the fuel container away along with any rags soaked in fuel or oil.
Make sure that no soundproofing panels made of porous material are soaked in fuel or oil.
Make sure that the ground or floor on which the machine is standing has not soaked up any fuel or oil.
- Fully tighten the tank plug each time after refuelling. Do not fill the tank right to the top but leave an adequate space for the fuel to expand. Fuel vapour is highly toxic. Only refuel outdoors or in a well ventilated place.
- Do not smoke or use naked flames when refuelling.
- The engine must be started in compliance with the specific instructions in the operation manual of the engine and/or machine itself. Do not use auxiliary starting aids that were not installed on the original machine (e.g. Startpilot®).
- Before starting, remove any tools that were used to service the engine and/or machine.
Make sure that all guards have been refitted.
- During operation, the surface of the engine can become dangerously hot.
Avoid touching the exhaust system in particular.
- Before proceeding with any operation on the engine, stop it and allow it to cool.

- Never carry out any operation whilst the engine is running.
- The coolant fluid circuit is under pressure.
Never carry out any inspections until the engine has cooled and even in this case, only open the radiator plug or expansion chamber with the utmost caution, wearing protective garments and goggles. If there is an electric fan, do not approach the engine whilst it is still hot as the fan could also start operating when the engine is at a standstill.
Only clean the coolant system when the engine is at a standstill.
- When cleaning the oil-cooled air filter, make sure that the old oil is disposed of in the correct way in order to safeguard the environment.
The spongy filtering material in oil-cooled air filters must not be soaked in oil.
The reservoir of the separator pre-filter must not be filled with oil.
- The oil must be drained whilst the engine is hot (oil T ~ 80°C).
Particular care is required to prevent burns.
Do not allow the oil to come into contact with the skin.
- Pay attention to the temperature of the oil filter when the filter itself is replaced.
- Only check, top up and change the coolant fluid when the engine is off and cold.
Take care to prevent fluids containing nitrites from being mixed with others that do not contain these substances since "Nitrosamine", dangerous for the health, can form.
The coolant fluid is polluting and must therefore be disposed of in the correct way to safeguard the environment.
- During operations that involve access to moving parts of the engine and/or removal of rotating guards, disconnect and insulate the positive wire of the battery to prevent accidental short-circuits and to stop the starter motor from being energized.
- Only check belt tension when the engine is off.
- Only use the eyebolts installed by **LOMBARDINI** to move the engine.
These lifting points are not suitable for the entire machine; in this case, the eyebolts installed by the manufacturer should be used.

GENERAL SAFETY DURING OPERATING PHASES

- The procedures contained in this manual have been tested and selected by the manufacturer's technical experts, and hence are to be recognised as authorised operating methods.
- Some tools are normal workshop ones, while others are special tools designed by the Manufacturer of the engine.
- All tools must be in good working condition so that engine components are not damaged and that operations are carried out properly and safely.
- It is important to wear the personal safety devices prescribed by work safety laws and also by the standards of this manual.
- Holes must be lined up methodically and with the aid of suitable equipment. Do not use your fingers to carry out this operation to avoid the risk of amputation.
- Some phases may require the assistance of more than one operator. If so, it is important to inform and train them regarding the type of activity they will be performing in order to prevent risks to the health and safety of all persons involved.
- Do not use flammable liquids (petrol, diesel, etc.) to degrease or wash components. Use special products.
- Use the oils and greases recommended by the manufacturer.
Do not mix different brands or combine oils with different characteristics.
- Discontinue use of the engine if any irregularities arise, particularly in the case of unusual vibrations.
- Do not tamper with any devices to alter the level of performance guaranteed by the manufacturer.

SAFETY AND ENVIRONMENTAL IMPACT

Every organisation has a duty to implement procedures to identify, assess and monitor the influence of its own activities (products, services, etc.) on the environment.
Procedures for identifying the extent of the impact on the environment must consider the following factors:

- Liquid waste
- Waste management
- Soil contamination
- Atmospheric emissions
- Use of raw materials and natural resources
- Regulations and directives regarding environmental impact

In order to minimise the impact on the environment, the manufacturer now provides a number of indications to be followed by all persons handling the engine, for any reason, during its expected lifetime.

- All packaging components must be disposed of in accordance with the laws of the country in which disposal is taking place.
- Keep the fuel and engine control systems and the exhaust pipes in efficient working order to limit environmental and noise pollution.
- When discontinuing use of the engine, select all components according to their chemical characteristics and dispose of them separately.

POSSIBLE CAUSES AND TROUBLE SHOOTING

THE ENGINE MUST BE STOPPED IMMEDIATELY WHEN:

- 1) - The engine rpms suddenly increase and decrease
- 2) - A sudden and unusual noise is heard
- 3) - The colour of the exhaust fumes suddenly darkens
- 4) - The oil pressure indicator light turns on while running.

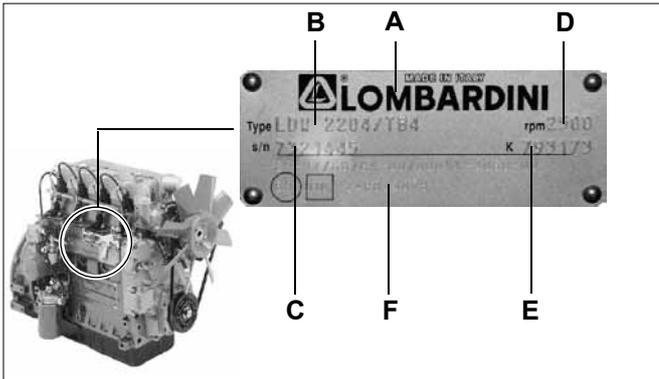
TABLE OF LIKELY ANOMALIES AND THEIR SYMPTOMS

The following table contains the possible causes of some failures which may occur during operation. Always perform these simple checks before removing or replacing any part.

POSSIBLE CAUSE		TROUBLE										
		Engine does not start	Engine starts but stops	No acceleration	Non-uniform speed	Black smoke	White smoke	Too low oil pressure	Overheats	Inadequate performance	Excessive oil consumption	High noise level
FUEL CIRCUIT	Obstructed fuel line											
	Fuel filter clogged											
	Air or water leaks in fuel system											
	The tank cap vent hole is clogged											
	No fuel											
ELECTRIC SYSTEM	Discharged battery											
	Cable connection uncertain or incorrect											
	Faulty starting switch											
	Faulty starting motor											
	Faulty glow plugs											
	Faulty glow plug control relay											
	Burnt fuse on preheating spark plugs											
MAINTENANCE	Clogged air filter											
	Excessive idle operation											
	Incomplete run-in											
	Overloaded engine											
SETTINGS REPAIRS	Incorrect governor linkage adjustment											
	Governor spring broken or unhooked											
	Low idle speed											
	Rings worn or sticking											
	Worn cylinder											
	Worn main con rod-rocker arm bearings											
	Badly sealed intake valve											
	Damaged cylinder head gasket											
	Defective timing system											
	Bent rods											
Faulty hydraulic tappets												

POSSIBLE CAUSE		TROUBLE										
		Engine does not start	Engine starts but stops	No acceleration	Non-uniform speed	Black smoke	White smoke	Too low oil pressure	Overheats	Inadequate performance	Excessive oil consumption	High noise level
INJECTION	Damaged injector											
	Injection pump valve damaged											
	Injector not adjusted											
	Faulty fuel feeding pump											
	Hardened pump control rod											
	Broken or loose supplementary start-up spring											
	Worn or damaged pumping element											
	Incorrect tuning of injection components (delivery balancing advance)											
	Cracked or broken precombustion chamber											
LUBRICATION CIRCUIT	Oil level too high											
	Oil level low											
	Oil pressure valve blocked or dirty											
	Worn oil pump											
	Oil sump suction line clogged											
	Faulty pressure gauge or pressure switch											
	Blocked draining pipe											
	Faulty spray nozzles (Turbo engines only).											
	Blocked draining pipe											
COOLING CIRCUIT	Alternator fan belt loose or torn											
	Clogged radiator exchange surface											
	Insufficient coolant											
	Fault fan, radiator or radiator plug											
	Faulty thermostatic valve											
	Blockage inside the radiator or the coolant ducts											
	Coolant leaking from radiator, hoses, the crankcase or from the water pump											
	Faulty or worn water pump											

MANUFACTURER AND MOTOR IDENTIFICATION DATA



The identification plate shown in the figure can be found directly on the engine.
It contains the following information:

- A) Manufacturer's identity
- B) Engine type
- C) Engine serial number
- D) Maximum operating speed
- E) Number of the customer version (form K)
- F) Approval data



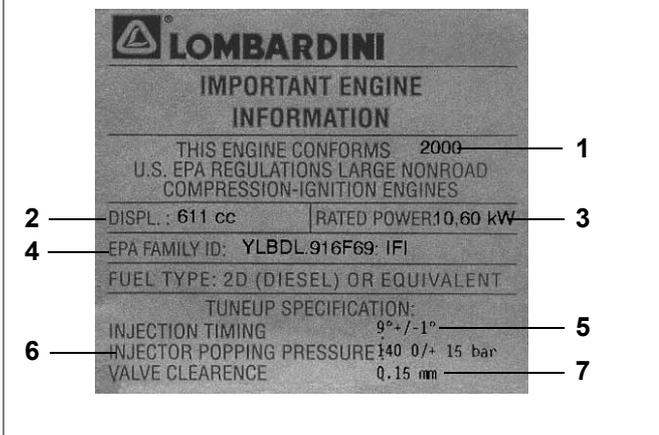
Approval data

The approval reference directives EC are on the engine plate.

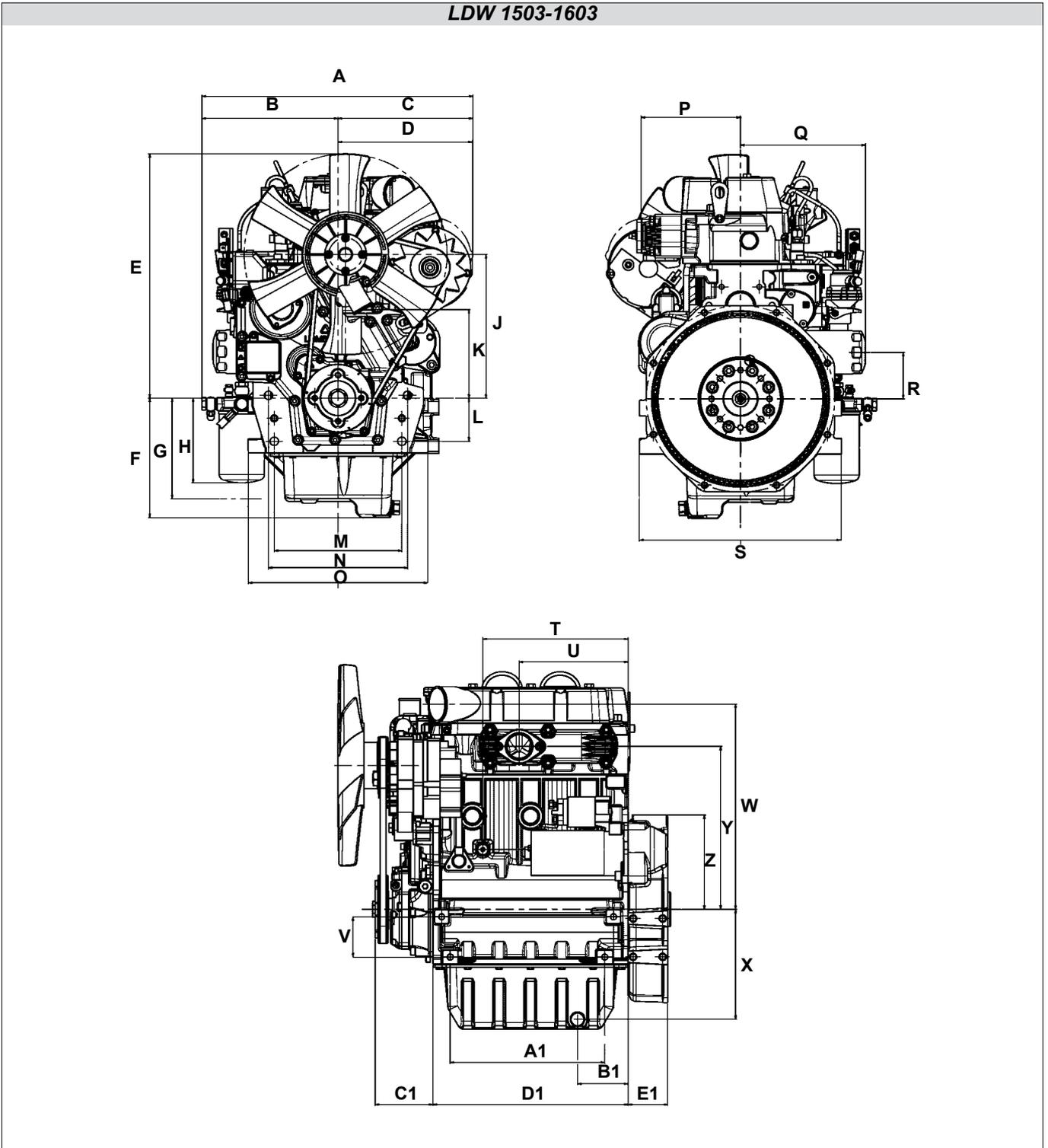
Plate for EPA regulations placed on the recoil starter or the rocker-arm cap.

It contains the following information:

- 1) Current year
- 2) Engine displacement
- 3) Rated power, measured in kW
- 4) EPA family ID
- 5) Injection timing
- 6) Injection opening pressure
- 7) Valve clearance



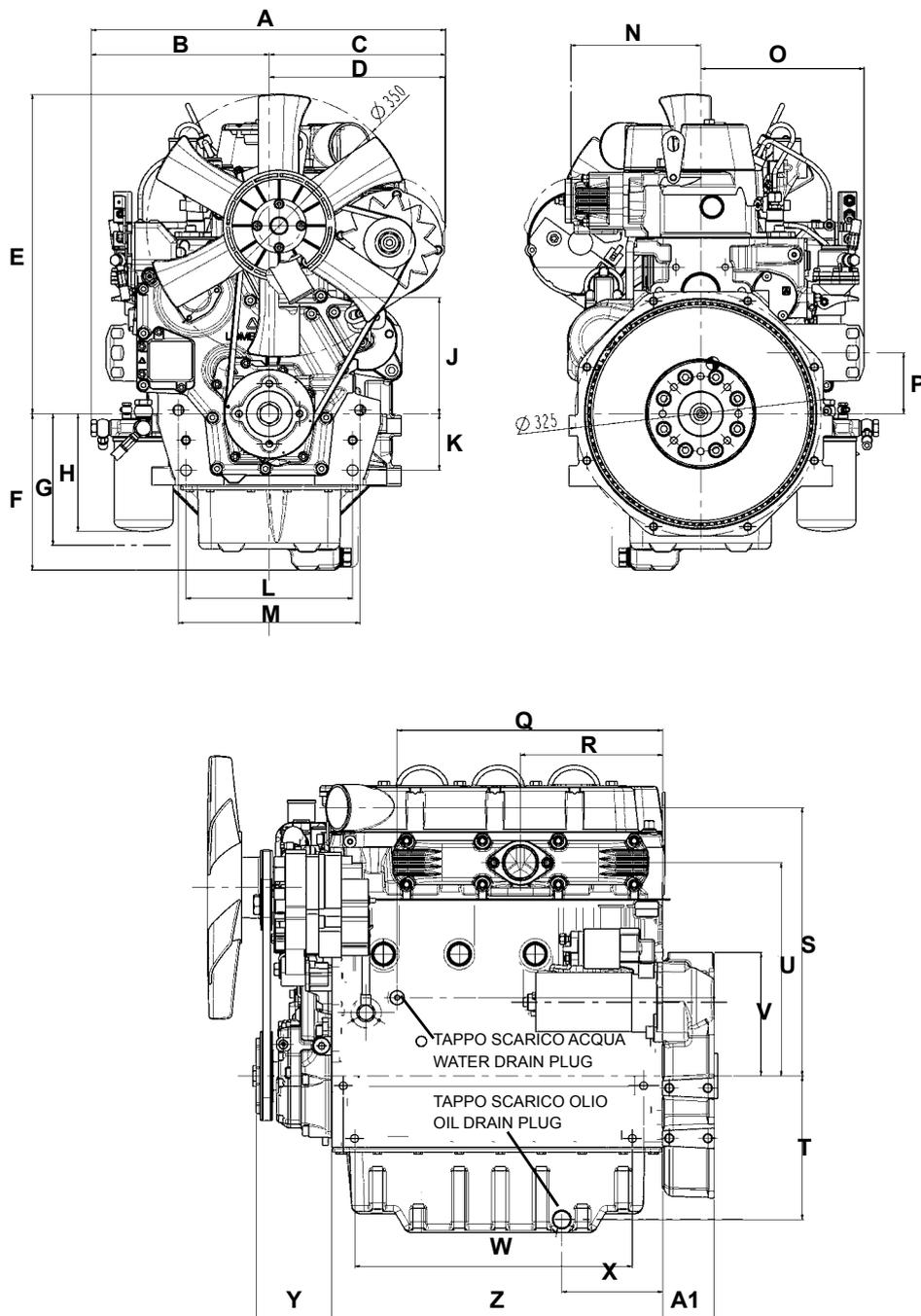
OVERALL DIMENSIONS



Note : Dimensions shown in mm

DIMENSIONS mm											
A	468	F	208	L	75	Q	215.7	V	70	A1	266
B	235	G	175	M	220	R	81	W	356.4	B1	87
C	233 max	H	147.5	N	240	S	348	X	191	C1	99.6
D	231.3	J	250.2	O	310	T	250	Y	283.3	D1	336
E	425.2	K	154.2	P	171	U	187.5	Z	164	E1	68

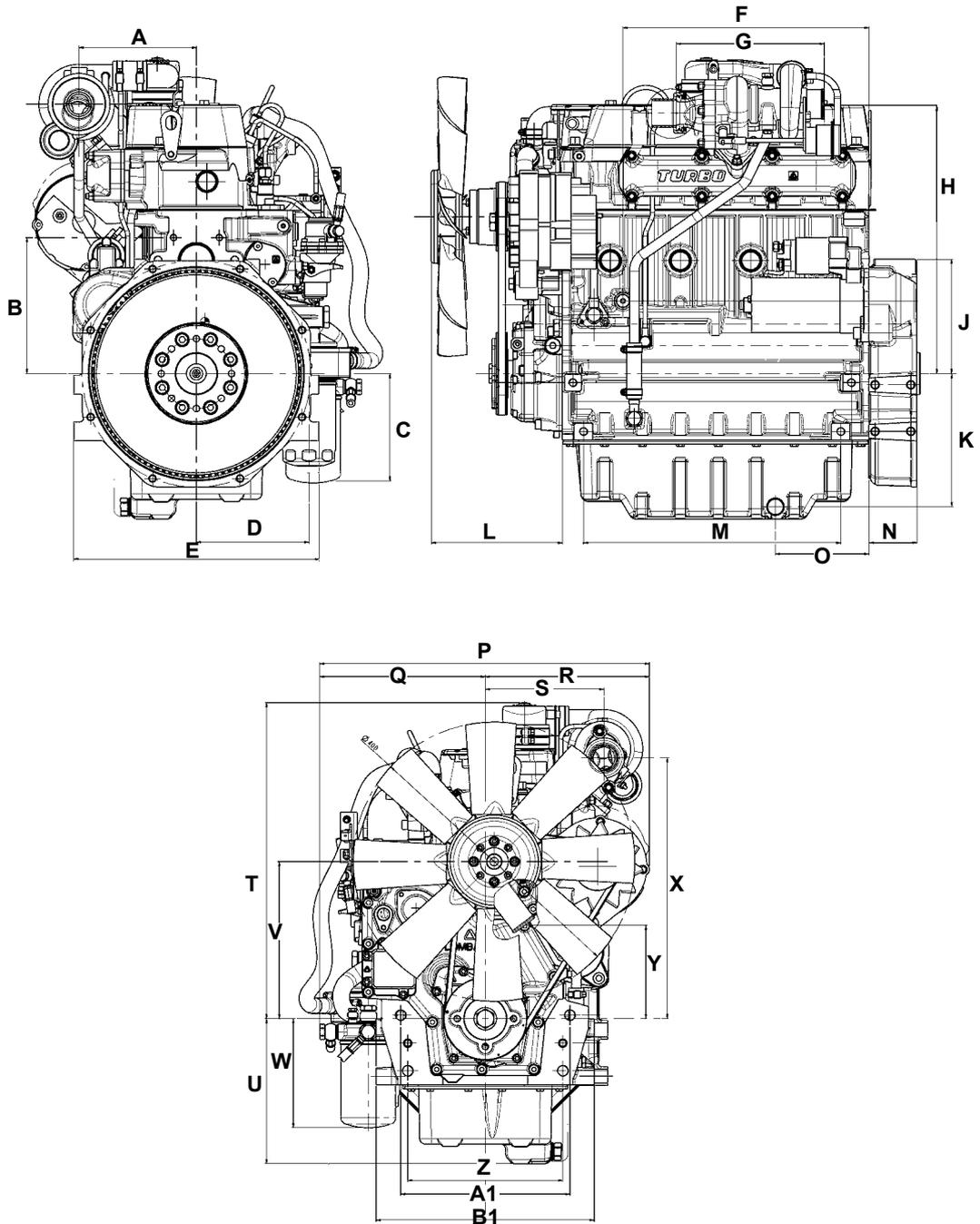
LDW 2004 - 2204



Note : Dimensions shown in mm

DIMENSIONS mm											
A	468	F	208	L	220	Q	350	V	164	A1	68
B	235	G	175	M	240	R	187.5	W	366		
C	233	H	156.5	N	171	S	356.3	X	133		
D	231.3	J	154.2	O	215.7	T	191	Y	99.6		
E	425.2	K	75	P	81	U	283.3	Z	436		

LDW 2004/T - 2204/T



Note : Dimensions shown in mm

DIMENSIONS mm											
A	166.7	F	350	L	186.3	Q	235	V	224.8	A1	210
B	195	G	210	M	366	R	233.1	W	156.5	B1	310
C	153.5	H	386.1	N	68	S	168.7	X	373.2		
D	160	J	164	O	133	T	452.5	Y	133.5		
E	348	K	190.5	P	468.1	U	208	Z	220		

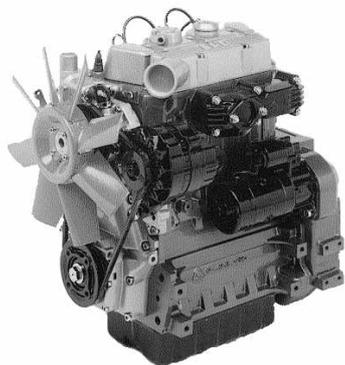
TECHNICAL SPECIFICATIONS

ENGINE TYPE CHD		LDW 1503	LDW 2004	LDW 2004/T
Cylindres	N.	3	4	4
Bore	mm	88	88	88
Stroke	mm	85	85	85
Displacement	Cm ³	1551	2068	2068
Compression ratio		22:1	22:1	22:1
R.P.M.		3000	3000	3000
Power KW	N 80/1269/CEE-ISO 1585-DIN 70020	26.4	35	44.1
	NB ISO 3046 - 1 IFN - DIN 6270	24.6	33.0	42.0
	NA ISO 3046 - 1 ICXN - DIN 6270	22.2	29.6	37.8
Max. torque *	Nm @ RPM	95.4 @ 2100	128 @ 2100	165.7 @ 2000
Max. torque 3rd + 4th p.t.o.	Nm @ RPM	39.2 @ 3000	39.2 @ 3000	39.2 @ 3000
Oil consumption **	Kg/h	0.024	0.032	0.04
Dry weight	Kg	155	190	195
Combustion air volume at 3000 r.p.m.	l/min	2326	3100	3900
Cooling air volume at 3000 r.p.m.	m ³ /min	108.3	128	180
Max. permissible driving shaft axial load in both directions	Kg	300	300	300
Max inclination	Max. 60 seconds	35°	35°	35°
	Lasting up to 30 seconds	25°	25°	25°
	Permanent	***	***	***
Firing Order		1-3-2	1-3-4-2	1-3-4-2

* Referred to max. N power

** At NA power

*** Depending on the application

LDW 1503

LDW 2004/T

LDW 2004

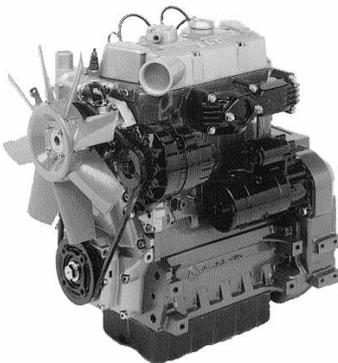

ENGINE TYPE CHD PLUS		LDW 1603	LDW 2204	LDW 2204/T
Cylindres	N.	3	4	4
Bore	mm	88	88	88
Stroke	mm	90.4	90.4	90.4
Displacement	Cm ³	1649	2199	2199
Compression ratio		22:1	22:1	22:1
R.P.M.		3000	3000	3000
Power KW	N 80/1269/CEE-ISO 1585-DIN 70020	30.0	38.0	49.2
	NB ISO 3046 - 1 IFN - DIN 6270	27.6	34,5	47
	NA ISO 3046 - 1 ICXN - DIN 6270	25.4	32.0	42.3
Max. torque *	Nm @ RPM	113 @ 1600	144 @ 2200	190 @ 1800
Max. torque 3rd + 4th p.t.o.	Nm @ RPM	39.2 @ 3000	39.2 @ 3000	39.2 @ 3000
Oil consumption **	kg/h	0.019	0.025	0.04
Dry weight	kg	156	192	197
Combustion air volume at 3000 r.p.m.	l/min	2475	3300	4200
Cooling air volume at 3000 r.p.m.	m ³ /min	96	128	180
Max. permissible driving shaft axial load in both directions	kg	300	300	300
Max inclination	Max. 60 seconds	35°	35°	35°
	Lasting up to 30 seconds	25°	25°	25°
	Permanent	***	***	***
Firing Order		1-3-2	1-3-4-2	1-3-4-2

* Referred to max. N power

** At NA power

*** Depending on the application

LDW 1603



LDW 2204/T

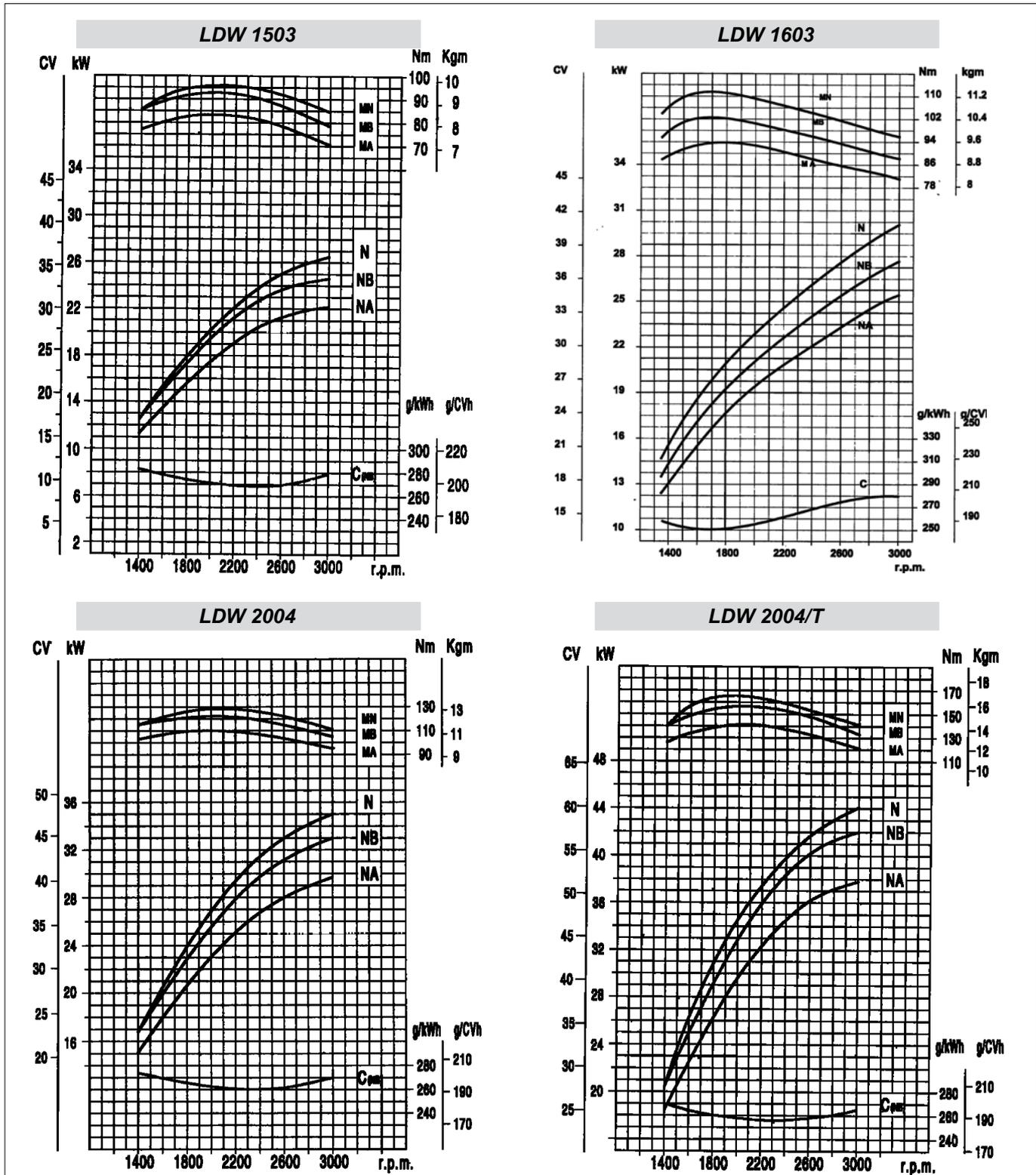


LDW 2204



PERFORMANCE DIAGRAMS

CHARACTERISTICS POWER, TORQUE AND SPECIFIC FUEL CONSUMPTION CURVES



N (80/1269/CEE - ISO 1585) AUTOMOTIVE RATING: intermittent operation with variable speed and variable load.

NB (ISO 3046 - 1 IFN) RATING WITH NO OVERLOAD CAPABILITY: Continuous light duty operation with constant speed and variable load.

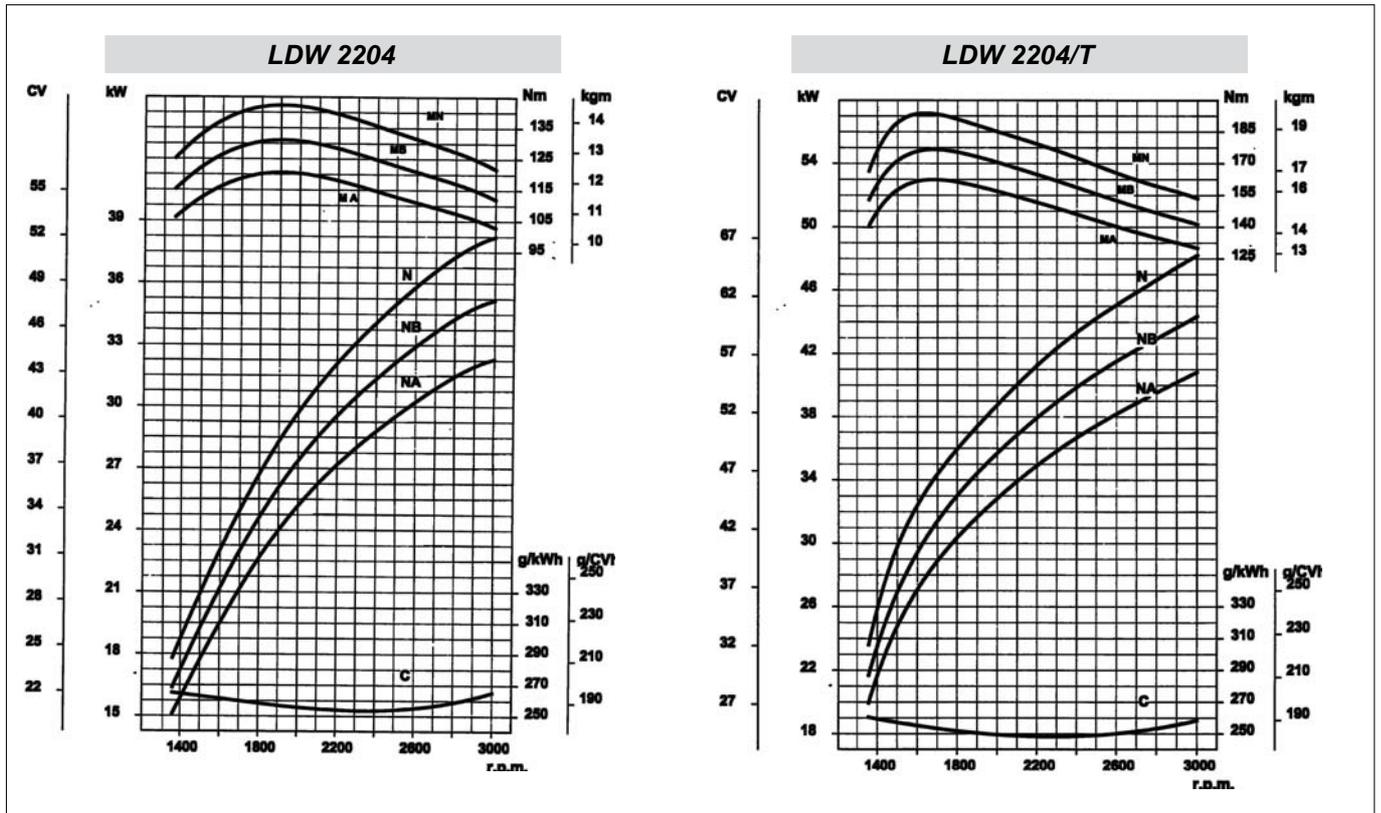
NA (ISO 3046 - 1 ICXN) CONTINUOUS RATING WITH OVERLOAD CAPABILITY: continuous heavy duty with constant speed and constant load.

MN Torque curve (N curve) - MB (NB curve) - MA (NA curve) - C: Specific fuel consumption curve (NB curve)

Max. power tolerance is 5%. Power decreases by approximately 1% every 100 m altitude and by 2% every 5°C above 25°C.

Engine power can be influenced by the type of coupling used with the cooling fan.

CHARACTERISTICS POWER, TORQUE AND SPECIFIC FUEL CONSUMPTION CURVES



N (80/1269/CEE - ISO 1585) AUTOMOTIVE RATING: intermittent operation with variable speed and variable load.
NB (ISO 3046 - 1 IFN) RATING WITH NO OVERLOAD CAPABILITY: Continuous light duty operation with constant speed and variable load.
NA (ISO 3046 - 1 ICXN) CONTINUOUS RATING WITH OVERLOAD CAPABILITY: continuous heavy duty with constant speed and constant load.

MN Torque curve (N curve) - MB (NB curve) - MA (NA curve).
C: Specific fuel consumption curve (NB curve)

Max. power tolerance is 5%.
 Power decreases by approximately 1% every 100 m altitude and by 2% every 5°C above 25°C.
 Engine power can be influenced by the type of coupling used with the cooling fan.



Important

Non-approval by Lombardini for any modifications releases the company from any damages incurred by the engine.

Note: Consult LOMBARDINI for power, torque curves and specific consumptions at rates differing from those given above.

ROUTINE ENGINE MAINTENANCE

Caution – Warning

Failure to carry out the operations described in the table may lead to technical damage to the machine and/or system.

EXTRAORDINARY MAINTENANCE

AFTER THE FIRST 50 WORKING HOURS

Engine oil replacement.

Oil filter replacement.

ORDINARY MAINTENANCE

OPERATION DESCRIPTION		FREQUENCY x HOURS							
		10	200	300	600	1200	5000	10000	
CHECK	LEVEL ENGINE LUBRICANT								
	COOLANT LEVEL								
	DRY AIR CLEANER	(***)							
	OIL BATH AIR CLEANER								
	RADIATOR EXCHANGE SURFACE								
	BELT FAN/ALTERNATOR STRETCH	(*)							
	SLEEVES	(*)							
	SETTING AND INJECTORS CLEANING	(**)							
	FUEL PIPES								
	RUBBER INTAKE HOSE (AIR FILTER – INTAKE MANIFOLD)								
	INTERIOR RADIATOR CLEANING								
	ALTERNATOR AND STARTER MOTOR								
	REPLACEMENT	ENGINE LUBRICANT	(*) (°)						
OIL FILTER		(*)							
FUEL FILTER		(*)							
ALTERNATOR FAN BELT		(**)							
COOLANT LEVEL		(**)							
PARTIAL OVERHAUL									
TOTAL OVERHAUL									
FUEL PIPES		(**)							
RUBBER INTAKE HOSE (AIR FILTER – INTAKE MANIFOLD)		(**)							
SLEEVES		(**)							
DRY AIR CLEANER EXTERNAL CARTRIDGE		(***)	AFTER 6 CHECKS WITH CLEANING						
DRY AIR CLEANER INTERNAL CARTRIDGE		(***)	AFTER 3 CHECKS WITH CLEANING						

200 STANDARD OIL SUMP

300 ENHANCED OIL SUMP

(*) - In case of low use: every year.

(**) - In case of low use: every 2 years.

(***) - The period of time that must elapse before cleaning or replacing the filter element depends on the environment in which the engine operates. The air filter must be cleaned and replaced more frequently in very dusty conditions.

(°) - If you are using oil of a quality lower than the prescribed one then you will have to replace it every 125 hours for the standard sump and every 150 hours for the enhanced sump.

LUBRICANT

SAE Classification

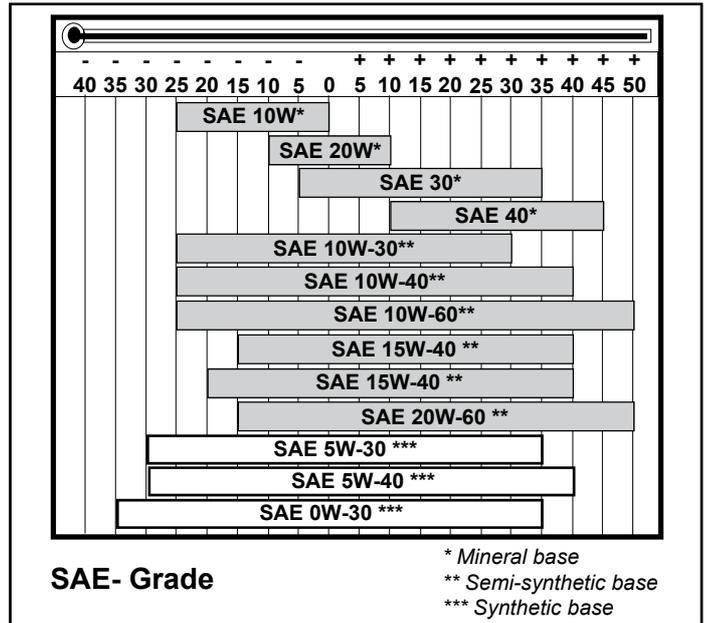
In the SAE classification, oils differ on the basis of their viscosity, and no other qualitative characteristic is taken into account.

The first number refers to the viscosity when the engine is cold (symbol W = winter), while the second considers viscosity with the engine at régime.

The criteria for choosing must consider, during winter, the lowest outside temperature to which the engine will be subject and the highest functioning temperature during summer.

Single-degree oils are normally used when the running temperature varies scarcely.

Multi-degree oil is less sensitive to temperature changes.



International specifications

They define testing performances and procedures that the lubricants need to successfully respond to in several engine testing and laboratory analysis so as to be considered qualified and in conformity to the regulations set for each lubrication kind.

A.P.I : (American Petroleum Institute)

MIL : Engine oil U.S. military specifications released for logistic reasons

ACEA : European Automobile Manufacturers Association

Tables shown on this page are of useful reference when buying a kind of oil.

Codes are usually printed-out on the oil container and the understanding of their meaning is useful for comparing different brands and choosing the kind with the right characteristics.

Usually a specification showing a following letter or number is preferable to one with a preceding letter or number.

An SF oil, for instance, is more performing than a SE oil but less performing than a SG one.

ACEA Regulations - ACEA Sequences

PETROL

A1 = Low-viscosity, for frictions reduction

A2 = Standard

A3 = High performances

LIGHT DUTY DIESEL ENGINES

B1 = Low-viscosity, for frictions reduction

B2 = Standard

B3 = High performances (indirect injection)

B4 = High quality (direct injection)

HEAVY DUTY DIESEL ENGINES

~~E1 = OBSOLETE~~

E2 = Standard

E3 = Heavy conditions (Euro 1 - Euro 2 engines)

E4 = Heavy conditions (Euro 1 - Euro 2 - Euro 3 engines)

E5 = High performances in heavy conditions (Euro 1 - Euro 2 - Euro 3 engines)

API / MIL Sequences

	DIESEL								PETROL							
API	CH-4	CG-4	CF-4	CF-2	CF	CE	CD	CC	SC	SD	SE	SF	SG	SH	SJ	SL
MIL			L- 46152 D / E													
	CORRENTI - CURRENT								OBSOLETI - OBSOLETE							

PRESCRIBED LUBRICANT

AGIP SINT 2000 TURBODIESEL 5W40	specifications	API CF - SH ACEA B3-B4 MIL - L-2104 C/46152 D
--	----------------	--

In the countries where AGIP products are not available, use oil API CF/SH for Diesel engines or oil corresponding to the military specification MIL-L-2104 C/46152 D.

CHD ENGINES OIL CAPACITY			LDW 1503-1603	LDW 2004 - 2004/T 2204 - 2204/T
OIL VOLUME AT MAX LEVEL (OIL FILTER INCLUDED)	Sheet STD oil sump.	Litres	4.4	6.4 - 5.3*
	ENHANCED aluminium oil sump.		7.1	9.5
OIL VOLUME AT MAX LEVEL (WITHOUT OIL FILTER)	Sheet STD oil sump.	Litres	3.8	5.7 - 4.5*
	ENHANCED aluminium oil sump.		6.4	8.8

* With dynamic balancer


Important

If you are using oil of a quality lower than the prescribed one then you will have to replace it every 125 hours for the standard sump and every 150 hours for the enhanced sump.


Danger – Attention

- The engine may be damaged if operated with insufficient lube oil. It is also dangerous to supply too much lube oil to the engine because a sudden increase in engine rpm could be caused by its combustion.
- Use proper lube oil preserve your engine. Good quality or poor quality of the lubricating oil has an affect on engine performance and life.
- If inferior oil is used, or if your engine oil is not changed regularly, the risk of piston seizure, piston ring sticking, and accelerated wear of the cylinder liner, bearing and other moving components increases significantly.
- Always use oil with the right viscosity for the ambient temperature in which your engine is being operated.


Danger – Attention

- The used engine oil can cause skin-cancer if kept frequently in contact for prolonged periods.
- If contact with oil cannot be avoided, wash carefully your hands with water and soap as soon as possible.
- Do not disperse the oil in the ambient, as it has a high pollution power.

COOLANT

Danger – Attention

- The fluid coolant circuit is pressurized. Inspections must only be made when the engine has cooled and even in this case, the radiator or expansion chamber plug must be unscrewed with the utmost caution.
- If an electric fan is installed, do not approach a hot engine since the fan itself could start up even when the engine is at a standstill.
- Coolant fluid is polluting, it must therefore be disposed of in the correct way. Do not litter.

The anti-freeze protection liquid (AGIP ANTIFREEZE SPEZIAL) must be used mixed with water, preferably decalcified. The freezing point of the cooling mixture depends on the product concentration in water, it is therefore recommended to use a 50% diluted mixture which guarantees a certain degree of optimal protection. As well as lowering the freezing point, the permanent liquid also raises the boiling point.

Coolant refueling

ENGINE TYPE	LDW 1503 - 1603	LDW 2004 - 2204	LDW 2004/T - 2204/T
CAPACITY (Litres) Without radiator	4.00	5.50	5.70

For information concerning the capacity of Lombardini radiators, please contact Lombardini directly. The total volume for refilling the cooling liquid varies according to the type of engine and radiator.

FUEL RECOMMENDATIONS

Purchase diesel fuel in small quantities and store in clean, approved containers. Clean fuel prevents the diesel fuel injectors and pumps from clogging. Do not overfill the fuel tank. Leave room for the fuel to expand. Immediately clean up any spillage during refueling.

Never store diesel fuel in galvanized containers; diesel fuel and the galvanized coating react chemically to each other, producing flaking that quickly clogs filters or causes fuel pump or injector failure.

High sulfur content in fuel may cause engine wear. In those countries where diesel has a high sulfur content, it is advisable to lubricate the engine with a high alkaline oil or alternatively to replace the lubricating oil recommended by the manufacturer more frequently. The regions in which diesel normally has a low sulfur content are Europe, North America, and Australia.

PRESCRIBED LUBRICANT	
Fuel with low sulphur content	API CF4 - CG4
Fuel with high sulphur content	API CF

FUEL TYPE

For best results, use only clean, fresh, commercial-grade diesel fuel. Diesel fuels that satisfy the following specifications are suitable for use in this engine: ASTM D-975 - 1D or 2D, EN590, or equivalent.

FUELS FOR LOW TEMPERATURES

It is possible to run the engine at temperatures below 0°C using special winter fuels. These fuels reduce the formation of paraffin in diesel at low temperatures. If paraffin forms in the diesel, the fuel filter becomes blocked interrupting the flow of fuel.

Fuel can be:

- Summer up to 0°C
- Winter up to -10°C
- Alpine up to -20°C
- Arctic up to -30°C

BIODIESEL FUEL

Fuels containing less than 20% methyl ester or B20, are suitable for use in this engine. Biodiesel fuels meeting the specification of BQ-9000 or equivalent are recommended. DO NOT use vegetable oil as a biofuel for this engine.

Any failures resulting from the use of fuels other than recommended will not be warranted.

AVIATION FUEL

Aviation fuels suitable for use in this engine include JP5, JP4, JP8 and, JET-A (if 5 percent oil is added).

EMISSION CONTROL INFORMATION

**LOW SULFUR FUEL OR
ULTRA LOW SULFUR FUEL ONLY**

**EPA /CARB emission label must be
attached near the fuel inlet.**

RECOMMENDATIONS FOR DISASSEMBLING AND ASSEMBLING**Important**

To locate specific topics, the reader should refer to the index.

- Besides disassembly and reassembly operations this chapter also includes checking and setting specifications, dimensions, repair and operating instructions.
- Always use original LOMBARDINI spare parts for proper repair operations.
- The operator must wash, clean and dry components and assemblies before installing them.
- The operator must make sure that the contact surfaces are intact, lubricate the coupling parts and protect those that are prone to oxidation.
- Before any intervention, the operator should lay out all equipment and tools in such a way as to enable him to carry out operations correctly and safely.
- For safety and convenience, you are advised to place the engine on a special rotating stand for engine overhauls.
- Before proceeding with operations, make sure that appropriate safety conditions are in place, in order to safeguard the operator and any persons involved.
- In order to fix assemblies and/or components securely, the operator must tighten the fastening parts in a criss-cross or alternating pattern.
- Assemblies and/or components with a specific tightening torque must initially be fastened at a level lower than the assigned value, and then subsequently tightened to the final torque.

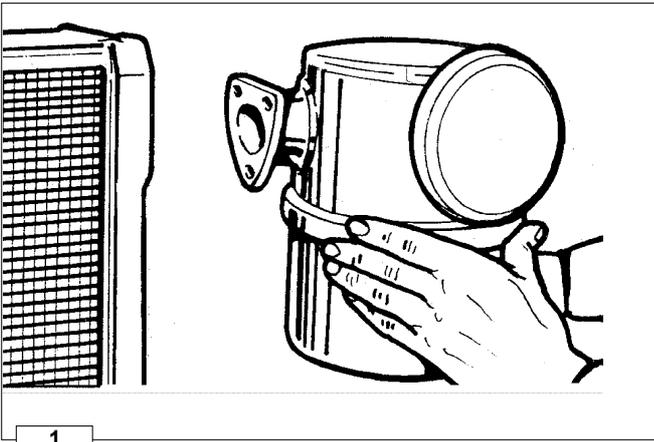
RECOMMENDATIONS FOR OVERHAULS AND TUNING**Important**

To locate specific topics, the reader should refer to the index.

- Before any intervention, the operator should lay out all equipment and tools in such a way as to enable him to carry out operations correctly and safely.
- The operator must comply with the specific measures described in order to avoid errors that might cause damage to the engine.
- Before carrying out any operation, clean the assemblies and/or components thoroughly and eliminate any deposits or residual material.
- Wash the components with special detergent and do not use steam or hot water.
- Do not use flammable products (petrol, diesel, etc.) to degrease or wash components. Use special products.
- Dry all washed surfaces and components thoroughly with a jet of air or special cloths before reassembling them.
- Apply a layer of lubricant over all surfaces to protect them against oxidation.
- Check all components for intactness, wear and tear, seizure, cracks and/or faults to be sure that the engine is in good working condition.
- Some mechanical parts must be replaced *en bloc*, together with their coupled parts (e.g. valve guide/valve etc.) as specified in the spare parts catalogue.

**Danger - Attention**

During repair operations, when using compressed air, wear eye protection.



1

Oil-bath air cleaner



Danger – Attention

Never clean the filtering element 6 using solvents with a highly flash point. This could cause an explosion !



Caution – Warning

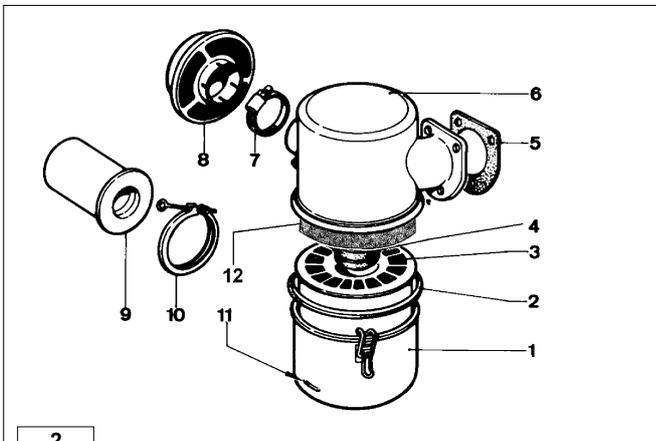
During repair operations, when using compressed air, wear eye protection.

Check gaskets and replace if necessary.
Check that flange welds are free of porosity or defective spots.
Carefully clean bowl and filtering element with Diesel fuel and dry with compressed air.

Top up engine oil to the mark (see below).

When refitting tighten nuts to 25 Nm

See page 22 for periodic cleaning and oil replacement.

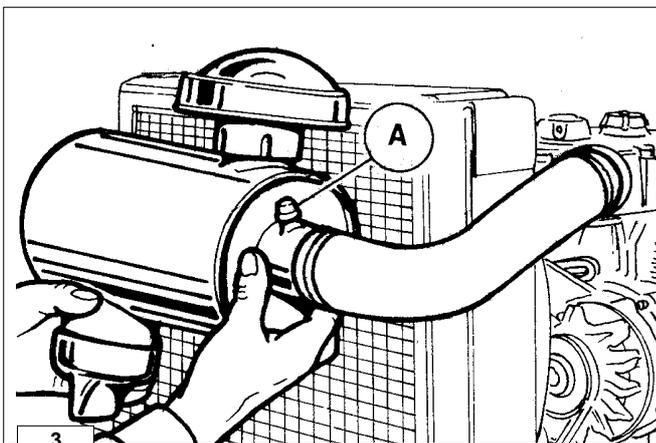


2

Oil-bath air cleaner components

- 1 Bowl
- 2 Outer seal ring
- 3 Lower filtering element
- 4 Inner seal ring
- 5 Gasket
- 6 Cover
- 7 Cap clamp
- 8 Cap
- 9 Centrifugal pre-filter
- 10 Centrifugal pre-filter clamp
- 11 Oil level mark
- 12 Upper filtering element (polyurethane sponge)

Note: Centrifugal pre-filter 9 is fitted upon request.



3

Dry air cleaner

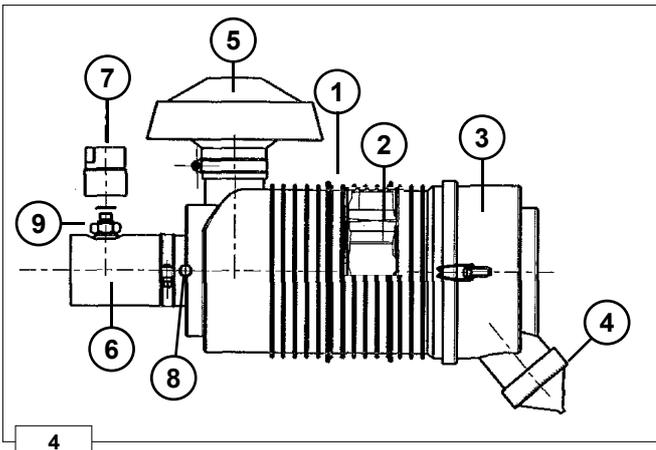


Danger – Attention

Never clean the filtering element using solvents with a low flash point. This could cause an explosion !

A = Fitting to accommodate clogging indicator

See page 22 for periodic dry air cleaner check and replacement and the rubber intake hose (air filter - intake manifold).



Dry air components

- 1 Main cartridge
- 2 Safety cartridge
- 3 Axial cover
- 4 Vacuator valve
- 5 Cap complete with clamp
- 6 Rubber connecting hose to the air filter - manifold or compressor.
- 7 Air filter restriction switch
- 8 Mounting for clogging indicator
- 9 Fastener

Scavenging valve 4 must be positioned as in figure 4.

The cartridge can be cleaned by blowing compressed air breadthways outside and inside the cartridge, at a pressure not greater than 5 atmospheres, or in necessity case by knocking the front of the cartridge several times against a flat surface.

Use a lamp to check that the filter element is not damaged or inspect it against the light while slanted. In case of doubt, install a new cartridge.

Air filter clogging indicator



Important

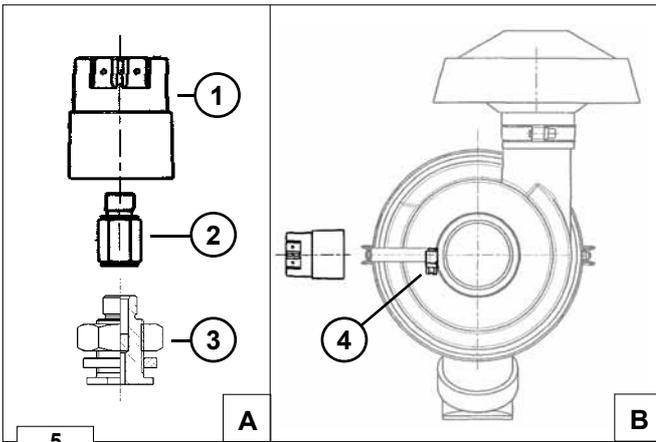
The indicator has to be tightened to mounting 4, as shown in fig. 5 B. Due to space requirements, it can be assembled by using special fastener 3 (fig. A) and by creating a hole of Ø14-15 mm in the rubber hose (see fig. 4).

- 1 Air filter restriction switch
- 2 Turbo adapter
- 3 Fastener
- 4 Mounting for clogging indicator

Note: There are two types: one for an aspirated engine and one for a supercharged engine.

Setting for aspirated engine (LDW 1503 - 1603 - 2004 - 2204) = 635 mm column of water.

Setting for supercharged engine (LDW 2004/T - 2204/T) = 380 mm column of water.

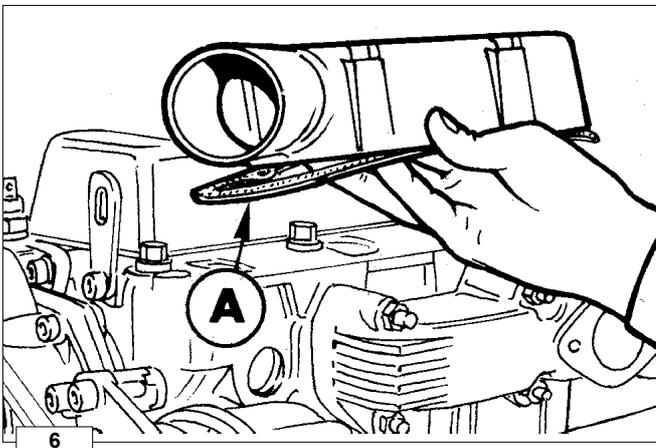


Intake manifold

The sealing surface should be clean, smooth and free of any strains and scoring.

When reassembly replace gasket A.

- Tighten the fastening screws to 25 Nm.



Exhaust manifold



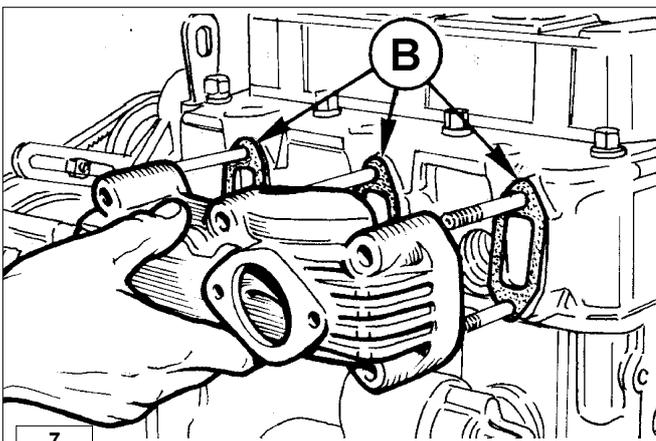
Danger – Attention

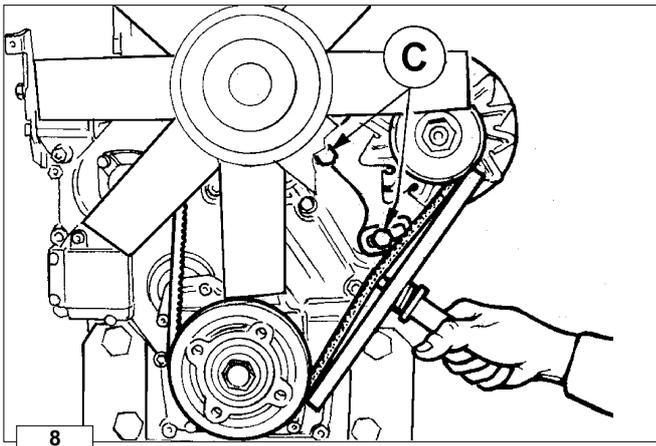
Allow the exhaust manifold to cool before demounting it in order to prevent scorching and burns.

Verify that the seal surfaces are free of distortions and scratches and that the manifold is not broken in any way.

When refitting, replace gaskets B.

- Tighten nuts to 25 Nm.





"V" belt



Danger – Attention

Check the belt tension only when the engine is not running.

Tension adjustment:

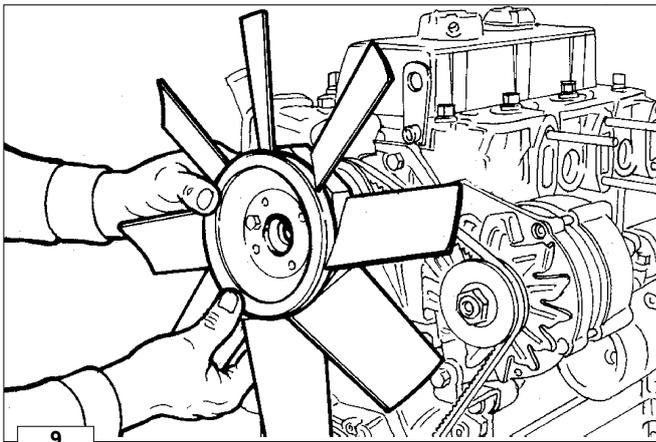
Loosen alternator fixing bolts C.

Stretch belt so that a 100 Nm load located half-way between the two pulleys causes a 10÷15 mm flexure.

Pull strongly alternator externally and tighten fixing bolts C.

The final torque must be 40 Nm.

If you use the belt tension gauge type DENSO BTG-2, the correct value of tension must be from 20 to 25 kg.



Cooling fan

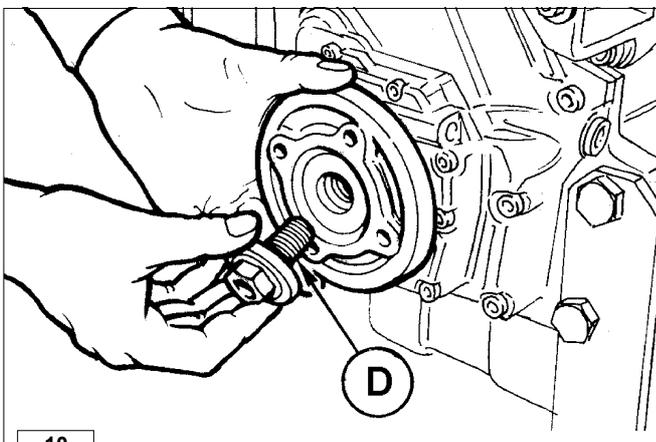


Danger – Attention

Before disassembling the cooling fan, isolate the positive battery cable to prevent accidental short-circuiting and, consequently, activation of the starter motor

Take off the fan and check that all blades are not damaged; if any are damaged, replace the entire fan.

Depending on the type of application the cooling fans can be suction or blower fans and can differ in diameter.

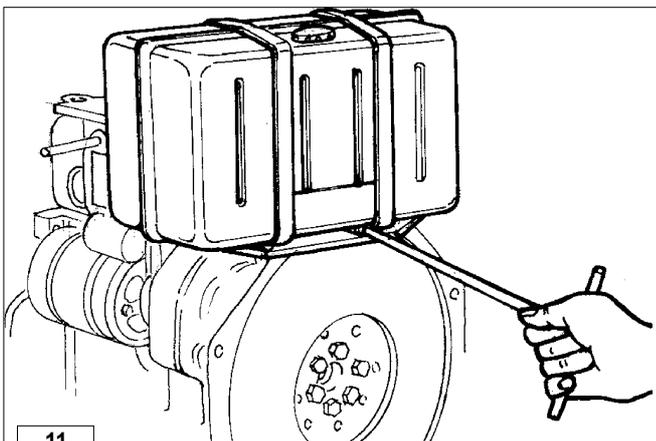


Driving pulley (2° P.T.O.)

The maximum torque that can be drawn from the second power take-off must be at maximum 70 Nm.

The driving pulley drives the alternator and the water pump and consequently the cooling fan.

Bolt D can be loosened by turning clockwise. When refitting lubricate the bolt with Moly slip and tighten it at 360 Nm.



Tank



Danger – Attention

To avoid explosions or fire outbreaks, do not smoke or use naked flames during the operations.

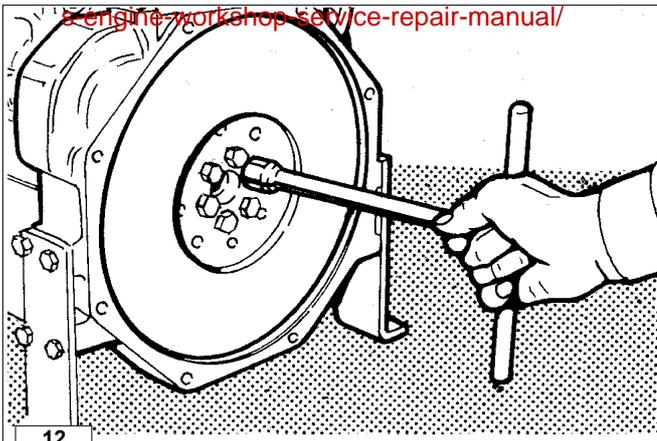
Fuel vapours are highly toxic. Only carry out the operations outdoors or in a well ventilated place.

Keep your face well away from the plug to prevent harmful vapours from being inhaled. Dispose of fuel in the correct way and do not litter as it is highly polluting.

Remove fuel line and loosen clamp screws.

Completely empty the tank and check that no impurities are found inside.

Check that cap breather hole is not clogged.



Flywheel



Caution – Warning

During the demounting phases, pay particular attention to prevent the flywheel from dropping as this could seriously injure the operator. Wear protective goggles when removing the flywheel ring.

Remove the bolts which attach the flywheel to the crankshaft; when refitting tighten to 140 Nm after checking that the locating pin is in its seat. To remove the starter ring gear, it is recommended to cut it into several portions with an iron hacksaw and then use a chisel. To remove the starter rim, it is advisable to cut it into several parts with a hacksaw and to then use a chisel. To replace, slowly heat for 15-20 minutes to a temperature of 300°C max. Fit the rim into the flywheel housing. make sure that it rests evenly against the support of the housing itself. Allow it to slowly cool.

Rocker arm cover with vent into the air

Components:

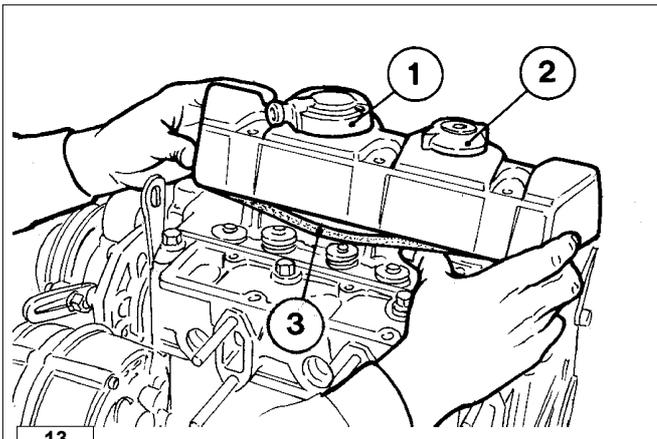
- 1 - Decanting device
- 2 - Oil fill cap
- 3 - Gasket

Inside the decanting device 1 there is a small metal skein that separates the oil from the bled vapours; before reassembling it, clean it and verify its intactness.



Important

Every time the rocker arm cap is removed replace the gasket 3.



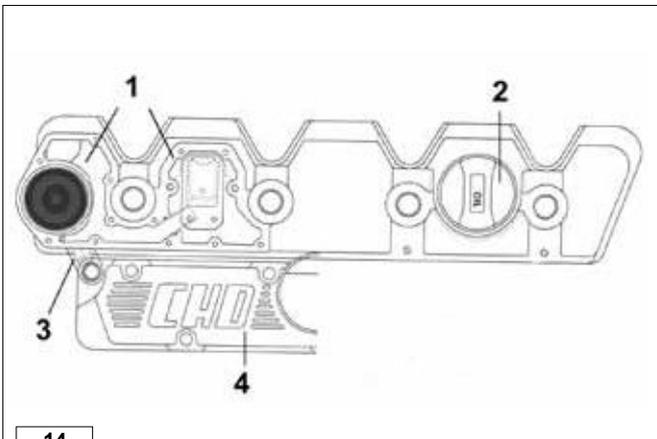
Rocker arm cover for engines with recirculating vent

Components:

- 1 - Recirculating vent system
- 2 - Oil refilling plug
- 3 - Rubber hose for the passage of the oil vapours
- 4 - Intake manifold

In the rocker arm cap we find most of the recirculating vent system 1. This device is used to separate the oil vapours and to convey them, via a rubber hose 3, into the intake manifold 4.

The vapours are then recirculated inside the engine and not released into the air as they can be polluting.



A clogged up air filter and a consequent increase in suction vacuum could cause the oil to be sucked into the combustion chamber and the engine over-revving.

This is in any case avoided as the diaphragm valve 7 by winning the resistance of spring 6 - properly calibrated - closes duct 5 and stops the oil from reaching manifold 4 via hose 3.

