WORKSHOP MANUAL

Focs series engines, code 1-5302-351

LDW 502
LDW 602
LDW 903
LDW 1204
LDW 1204/T

LDW 702
LDW 1003
LDW 1404

5st Edition

LOMBARDINI
intermotor SLANZI
SERVICE

FOREWORD

We have done all in our power to give up to date and accurate technical information in this manual. Lombardini engines are, however, constantly developing thus the data in this publication may be liable to modification without prior notice.

The information in this manual is the exclusive property of Lombardini. Neither partial nor total duplications or reprints are therefore permitted without the express authorization of Lombardini.

The information in this manual is given on the assumption that:

1- the persons who service Lombardini engines have been adequately trained and outfitted to safely and professionally carry out the necessary tasks;

2- the persons who service Lombardini engines possess the necessary skills and special Lombardini tools to safely and professionally carry out the necessary tasks;

3- the persons who service Lombardini engines have read the specific information concerning the above mentioned Service operations and that they have clearly understood the operations required.

GENERAL SERVICE NOTES

1 - Only use genuine Lombardini spare parts. Use of spurious spares may lead to incorrect performance and shorten the life of the engines.
2 - The metric system is used to express all data, i.e. the dimensions are given in millimeters (mm), torque is expressed in Newton-meters (Nm), weight in kilograms (Kg), volume in liters or cubic centimeters (cc) and pressure in barometric units (bar).

WARRANTY CERTIFICATE

Engine manufactured by Lombardini S.r.l., are warranted to be free of defects in workmanship or materials for 12 months from the date of delivery to the first purchaser or non more than two (2) years from date of engine delivery to the Original Equipment Manufacturer as defined by Lombardini invoicing, whichever occurs firsts, except as defined below.

Stationary applications, working at constant speed and/or slightly variable speeds, are excluded from the above terms. Stationary/fixed speed applications will be warranted to be free of material/workmanship defects for a maximum operational period of 1000 hours or 12months from the date of first purchase, whichever occurs first. The two (2) year limitation from date of Lombardini invoice will remain intact as described above.

Modification of Lombardini products by the Original Equipement Manufacturer or the end user with respect to cooling systems, filtration systems, induction systems, exhaust systems, lubrication system, fuel system, fuel system settings, etc., will require special written warranty agreements. A test certificate/approval by the R&D/ Application engineering department of Lombardini or associated Lombardini companies concerning modified Lombardini products will entitle Warranty as defined above. Warranty will not be granted on any modified Lombardini product without special written approval by Lombardini.

Within the above stated periods Lombardini will replace and/or repair, at the option of Lombardini, any part or component that, upon examination by Lombardini or an authorized Lombardini agent, is found to be defective in 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 replacemnt of any component will not extend or renew the warranty period. Direct labor required to make repairs or to replace components found to be defective in materials or workmanship will be completed at no cost to the end user. Lombardini in not responsible however for indirect costs of removing/installing the engine assembly. Further, Lombardini is not responsible for the costs of transportation of the machine or components requiring repair or for service supplies such as lubricating oils and filters.

Lombardini Warranty obligations will be cancelled if:

- Lombardini engines are applied to a given machine causing working engine parameters outside Lombardini application guidelines.
- Lombardini engines are not serviced and maintained according to the "USE and MAINTENANCE" booklet.
- Any seal affixed to the engine by Lombardini has been tampered with or removed.
- Engines have been disassembled, repaired or altered by any party other than an authorized Lombardini agent.
- Spare parts used are not original Lombardini.
- Fuel injection system/component failures caused by the use of unauthorized fuel types or poor quality fuels are not covered under the Lombardini warranty policy.
- Electrical system failures due to the modification of Lombardini supplied harnesses, modification of Lombardini supplied control panels, OEM/end user supplied/installed relays, controls, etc. are not covered under warranty.

Following expiration of the above stated warranty period(s) and limitations, Lombardini will have no further responsibility for warranty and will consider our obligation for warranty complete.

The above warranty certificate will be in effect starting July 1, 1993 and cancels/replaces any and all explicit or implicit warranty policies on the part of Lombardini. The above warranty conditions can from this date forward be modified only in writing.

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This manual contains pertinent information regarding the repair of LOMBARDINI water-cooled, indirect injection Diesel engines type **LDW 502-602-903-1204-124/T** and **LDW 702-1003-1404:** updated November 15, 1999.

INDEX

NOTE

TROUBLESHOOTING CHART- LDW FOCS SERIES

POSSIBLE CAUSE	SYMPTOM													
	Engine will not crank	Engine does not start	Engine starts, but stops	Poor acceleration	Unsteady RPM	Black smoke	White smoke	Blue smoke	Low oil pressure	Oil level rising	Excessive oil consumption	Wet exhaust	Overheating	Engine knocks
Low fuel level		▪	▪		▪									
Fuel supply/ return lines clogged		▪	▪	▪	▪									
Clogged fuel tank vent			▪		▪									
Fuel pump faulty		▪	▪							▪				
Fuel entrained with air		▪	▪	▪	▪									
Unit injector(s) faulty/ worn		▪		▪	▪	▪	▪			▪		▪		
Unit injector settings incorrect		▪		▪		▪	▪					▪	▪	▪
Injection pump rack sticking		▪		▪	▪									
Oil level too high				▪	▪	▪		▪				▪	▪	▪
Improper oil viscosity											▪	▪	▪	
Oil diluted by fuel									▪	▪	▪	▪	▪	
Oil pressure relief valve faulty									▪					
Oil pick-up tube clogged									▪					
Oil pump air entrained at pick-up tube									▪					
Glow plugs faulty		▪					▪							
Glow plug controller faulty		▪												
Glow plug relay inoperable		▪												
Starter defective	▪													
Battery voltage too low	▪													
Battery / battery cable connections corroded	▪													
Key switch defective	▪													
Air filter clogged		▪		▪	▪	▪					▪	▪	▪	
Excessive idle / light load operation							▪	▪			▪	▪		
Incomplete engine run-in								▪			▪	▪		
Engine overloaded		▪	▪	▪	▪	▪					▪		▪	
Excessive parasitic load	▪	▪				▪								
Valve lash insufficient / excessive		▪					▪	▪						▪
Injection timing out of spec- advanced		▪					▪	▪			▪			▪
Injection timing out of spec- retarded		▪		▪		▪								
Governor linkage adjustment incorrect		▪	▪	▪	▪									
Governor spring fatigued or defective		▪		▪	▪									
Idle rpm too low		▪	▪											
Piston rings worn or stuck		▪					▪	▪			▪	▪		
Piston worn or damaged		▪					▪	▪			▪	▪	▪	▪
Cylinders worn or damaged		▪					▪	▪			▪	▪	▪	▪
Valves / valve guides worn		▪					▪	▪			▪	▪		
Valves sticking		▪	▪	▪	▪		▪				▪	▪		
Bearings (main / rod) worn									▪				▪	▪
Governor / governor linkage malfunction		▪	▪	▪	▪	▪								
Cylinder head gasket damaged		▪					▪						▪	
Thermostat stuck or malfunctioning													▪	
Engine seized	▪													
Radiator clogged (external or internal)													▪	
Coolant pump faulty													▪	
Turbocharger faulty				▪	▪	▪		▪			▪	▪	▪	

SAFETY AND WARNING DECALS

DANGER

Failure to comply with the instructions could result in damage to persons and property

CAUTION

Failure to comply with the instructions could lead to technical damage to the machine and/or system

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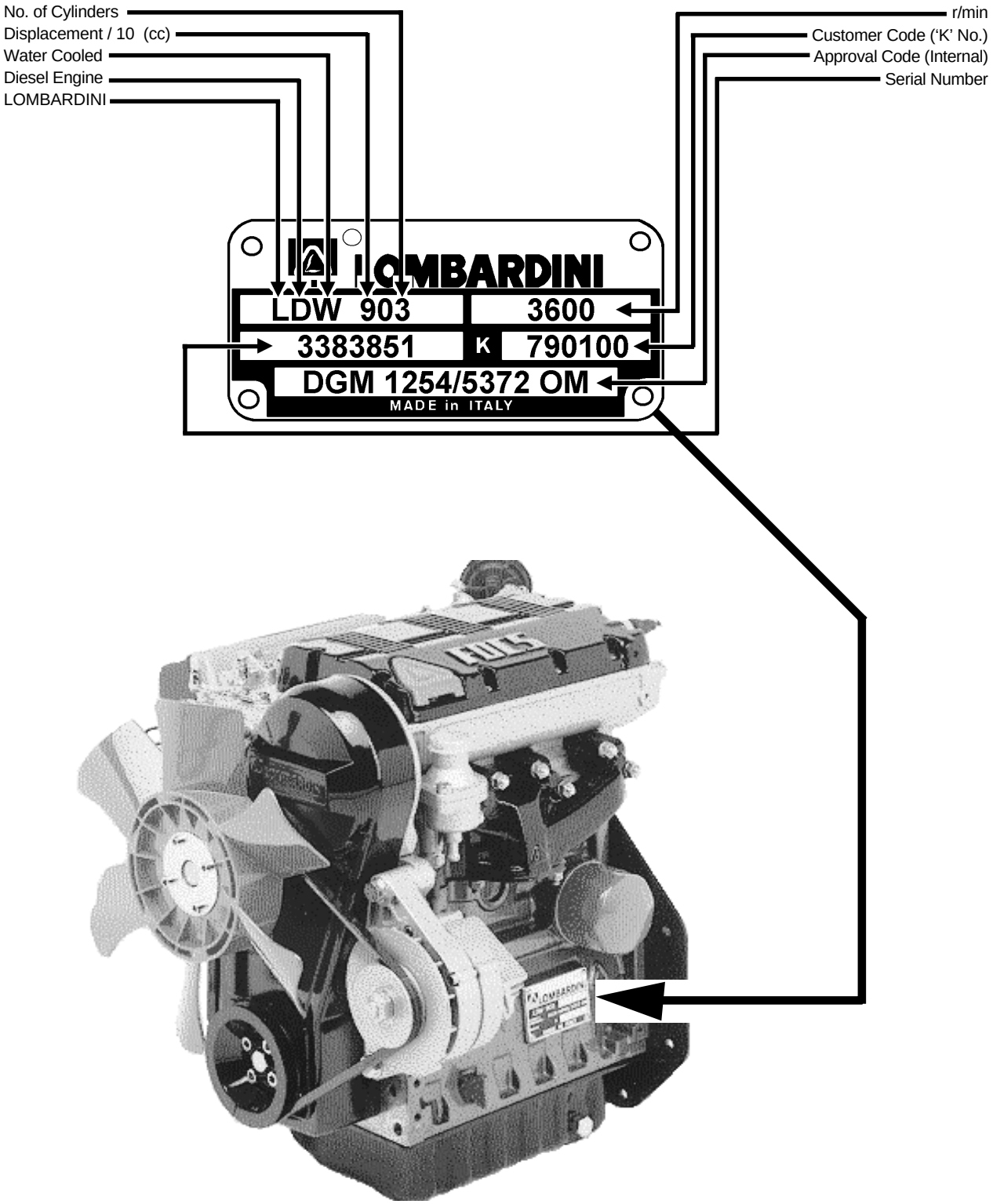
SAFETY INSTRUCTIONS

- 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 unles 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.
- Make sure that the drained oil, the oil filter and the oil it contains are disposed of in the correct way in order to safeguard the environment.
- 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.

All pertinent information needed for engine identification and spare parts ordering can be accessed from the engine data plate. Additionally, the maximum engine speed, “K’ number and approval codes are included on the engine data plate. The location of the data plate, as shown below, is identical for all LOMBARDINI LDW-FOCS industrial engines. Please supply the engine data plate information to your Authorized LOMBARDINI Distributor or Dealer when ordering replacement parts or when making technical inquiries.



COMPILER TECDATI	REG. CODE	MODEL N°	DATE OF ISSUE	REVISION 04	DATE	ENDORSED
	1-5302-351	50563	04.90		15.11.99	

POWER RATINGS FOR LDW-FOCS GENSET SPEC DIESEL ENGINES

CONTINUOUS (NA) RATING- kW

ENGINE MODEL	1500 r/min	1800 r/min	3000 r/min	3600 r/min
LDW 602	4.5	5.4	9.0	9.9
LDW 903	6.7	8.1	14.0	14.9
LDW 1204	9.0	10.8	18.9	19.9
LDW 1204/T	11.7	14.0	24.8	25.8
LDW 702	5.0	5.9	9.9	10.6
LDW 1003	7.7	9.0	14.9	16.3
LDW 1404	9.9	11.7	19.8	22.8

NOTE: THE ABOVE RATINGS ARE FLYWHEEL OUTPUT, NOT ELECTRICAL GENSET OUTPUT

INTERMITTENT (NB) RATING- kW

ENGINE MODEL	1500 r/min	1800 r/min	3000 r/min	3600 r/min
LDW 602	5.0	6.0	10.0	11.0
LDW 903	7.5	9.0	15.5	16.5
LDW 1204	10.0	12.0	21.0	22.0
LDW 1204/T	13.0	15.5	27.5	28.5
LDW 702	5.5	6.5	11.0	11.7
LDW 1003	8.5	10.0	16.5	18
LDW 1404	11.0	13.0	22.0	25

NOTE: THE ABOVE RATINGS ARE FLYWHEEL OUTPUT, NOT ELECTRICAL GENSET OUTPUT

POWER RATING STANDARDS

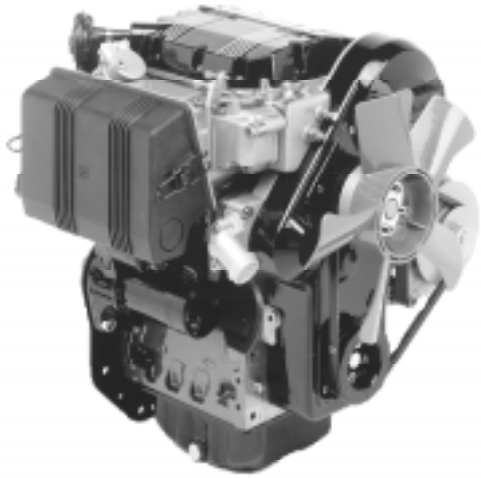
NB- ISO 3046/1-IFN - Maximum intermittent rating with no overload capacity; operation with constant speed and variable load.
NA- ISO 3046/1-ICXN- Continuous rating with 10% intermittent overload allowed; operation with constant speed and constant load.
Standard Rating Conditions: 25°C, 100kPa Total Barometric Pressure, 30% Relative Humidity.
Standard Production Power Tolerance = +/- 5%
Standard/ General Derations: 2% per 5°C increase in temperature over 25°C; 1% per 100m over mean sea level

LDW FOCS SERIES- TECHNICAL SPECIFICATIONS AND CAPACITIES					
TECHNICAL SPECIFICATIONS	**LDW 502**	**LDW 602**	**LDW 903**	**LDW 1204**	**LDW 1204/T**
No. of Cylinders	2	2	3	4	4
Firing Order	1-2	1-2	1-3-2	1-3-4-2	1-3-4-2
Cylinder Bore (mm)	72	72	72	72	72
Cylinder Stroke (mm)	62	75	75	75	75
Displacement (cc)	505	611	916	1222	1222
Aspiration Type	Natural	Natural	Natural	Natural	Turbo
Compression Ratio	22.8:1	22.8:1	22.8:1	22.8:1	22.8:1
RPM- maximum	3600	3600	3600	3600	3600
Power- (N)- ISO 1585- KW(CV)-@3600 r/min	9.8(13.4)	11.8(16.0)	17.2(23.4)	24.4(33.2)	31.0(42.0)
Power- (Nb)- ISO 3046-1 IFN- KW(CV)-@3600 r/min	9.1(12.4)	10.3(14.0)	15.6(21.2)	22.0(30.0)	28.5(38.7)
Power- (Na)- ISO 3046-1 ICXN- KW(CV)-@3600 r/min	8.2(11.2)	9.2(12.5)	13.7(18.6)	19.9(27.0)	25.8(35.0)
Torque(MAX)/rpm @Nb output, (Nm)	28.7/2400	34.5/2200	53.5/2000	75.1/2200	98/2400
Maximum Torque Available @ N0. 3 PTO (Nm)	37/1800	37/1800	37/1800	37/1800	37/1800
Fuel Consumption (Nb)@3600 rpm- (g/KWh)	326	282	300	290	305
Oil Consumption (Na)- (Kg/hr)	0.007	0.007	0.012	0.017	0.019
Dry Weight- (Kg)	60	65	85	96	101
Inclination (max)- (30 seconds)	35°	35°	35°	35°	35°
Inclination (max)- (60 seconds)	30°	30°	30°	30°	30°
Inclination (continuous)- APPLICATION DEPENDENT	****	****	****	****	****
Axial Load (max) on Crankshaft (both directions)- (Kg)	300	300	300	300	300
Radial (side) Load - APPLICATION DEPENDENT	****	****	****	****	****

**** - CONTACT LOMBARDINI APPLICATION ENGINEERING DEPARTMENT FOR DETAILS

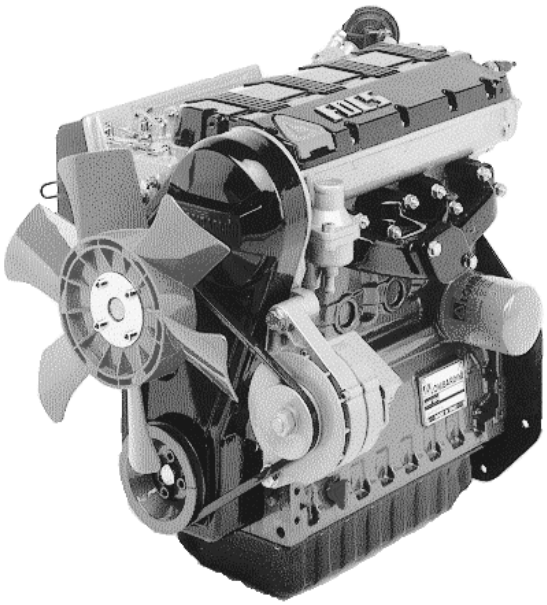
FLUID CAPACITIES (STANDARD)					
Oil Capacity (including oil filter)- (liters)	1.6	1.6	2.4	3.2	4.3
Oil Capacity (less oil filter)- (liters)	1.5	1.5	2.3	3.0	4.1
Coolant Capacity (including std. radiator)- (liters)	2.3	4.0	4.9	6.0	7.5
Coolant Capacity (engine only)- (liters)	0.8	0.9	1.3	1.8	2.0
Fuel Tank-standard (OPTIONAL)- (liters)	4.3	4.3	10.0	15.0	15.0

NOTE: The above cooling system capacities (including radiator) assume that the radiator fitted to your Lombardini FOCS series diesel engine is the standard Lombardini radiator. Different OEM machines may or may not be fitted with a standard Lombardini radiator. Always refer to your equipment documentation for capacity details.

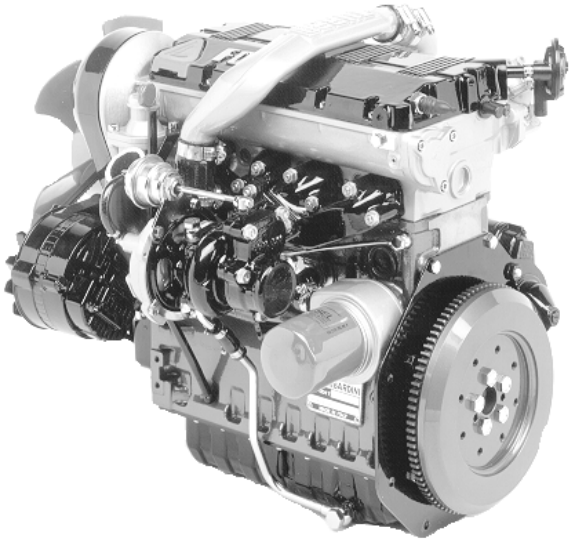


LDW 502/602

LDW 903



LDW 1204



LDW 1204/T

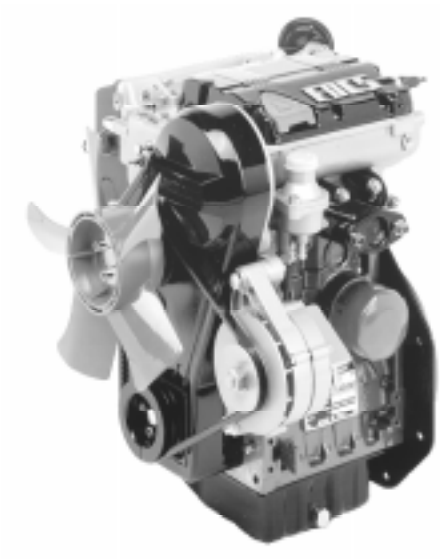
LDW FOCS SERIES- TECHNICAL SPECIFICATIONS AND CAPACITIES			
TECHNICAL SPECIFICATIONS	**LDW 702**	**LDW 1003**	**LDW 1404**
No. of Cylinders	2	3	4
Firing Order	1-2	1-3-2	1-3-4-2
Cylinder Bore (mm)	75	75	75
Cylinder Stroke (mm)	77.6	77.6	77.6
Displacement (cc)	686	1028	1372
Aspiration Type	Natural	Natural	Natural
Compression Ratio	22.8:1	22.8:1	22.8:1
RPM- maximum	3600	3600	3600
Power- (N)- ISO 1585- KW(CV)-@3600 r/min	13(17.7)	20(27.2)	27.2(36.7)
Power- (Nb)- ISO 3046-1 IFN- KW(CV)-@3600 r/min	11.7(16)	18(24.5)	25(34)
Power- (Na)- ISO 3046-1 ICXN- KW(CV)-@3600 r/min	10.6(14.4)	16.3(22.2)	22.8(31)
Torque(MAX)/rpm @Nb output, (Nm)	40/2200	59/2200	82.5/2200
Maximum Torque Available @ N0. 3 PTO (Nm)	37/1800	37/1800	37/1800
Fuel Consumption (Nb)@3600 rpm- (g/KWh)	320	300	325
Oil Consumption (Na)- (Kg/hr)	0.009	0.013	0.019
Dry Weight- (Kg)	66	87	98
Inclination (max)- (30 seconds)	35°	35°	35°
Inclination (max)- (60 seconds)	30°	30°	30°
Inclination (continuous)- APPLICATION DEPENDENT	****	****	****
Axial Load (max) on Crankshaft (both directions)- (Kg)	300	300	300
Radial (side) Load - APPLICATION DEPENDENT	****	****	****

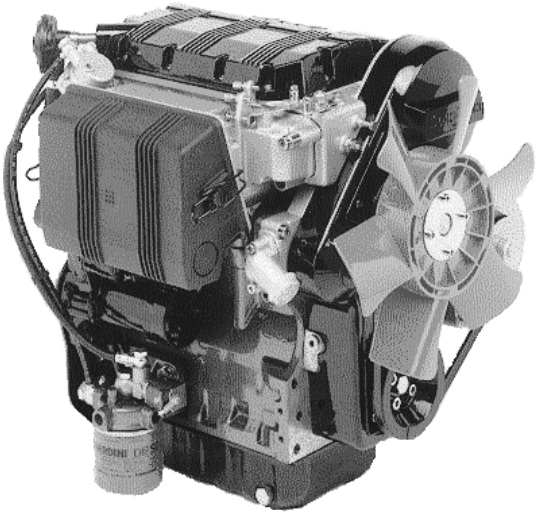
**** - CONTACT LOMBARDINI APPLICATION ENGINEERING DEPARTMENT FOR DETAILS

FLUID CAPACITIES (STANDARD)			
Oil Capacity (including oil filter)- (liters)	1.6	2.4	3.2
Oil Capacity (less oil filter)- (liters)	1.5	2.3	3.0
Coolant Capacity (including std. radiator)- (liters)	2.3	4.9	6.0
Coolant Capacity (engine only)- (liters)	0.9	1.3	1.7
Fuel Tank-standard (OPTIONAL)- (liters)	4.3	4.3	10.0

NOTE: The above cooling system capacities (including radiator) assume that the radiator fitted to your Lombardini FOCS series diesel engine is the standard Lombardini radiator. Different OEM machines may or may not be fitted with a standard Lombardini radiator. Always refer to your equipment documentation for capacity details.

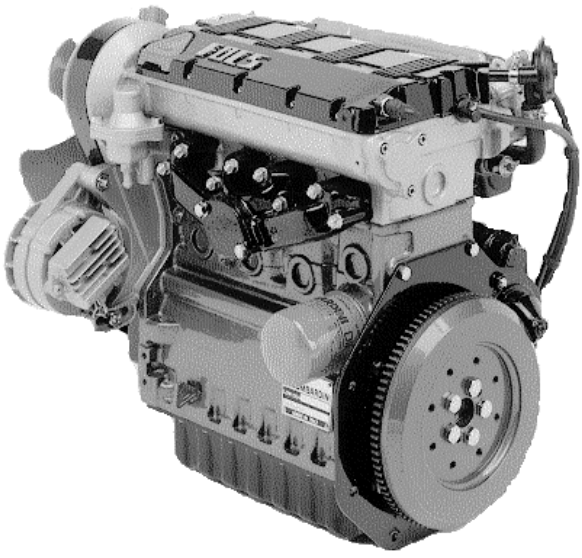
LDW 702





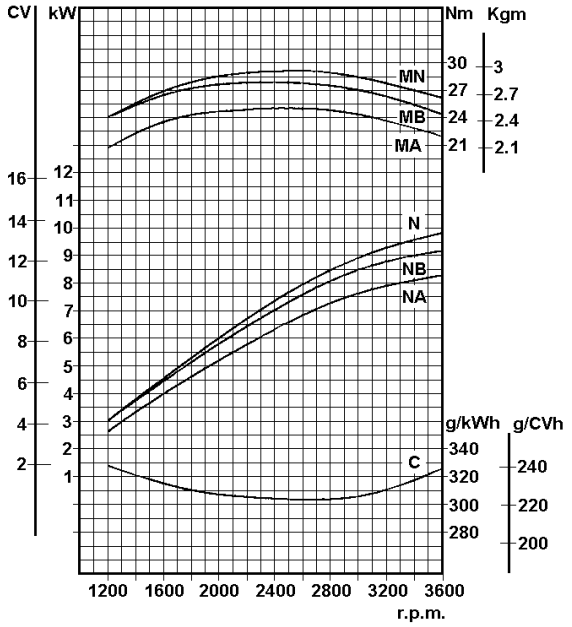
LDW 1003

LDW 1404



POWER, TORQUE AND SPECIFIC FUEL CONSUMPTION CURVES
LDW 502 FOCS, LDW 602 FOCS, LDW 903 FOCS

LDW 502



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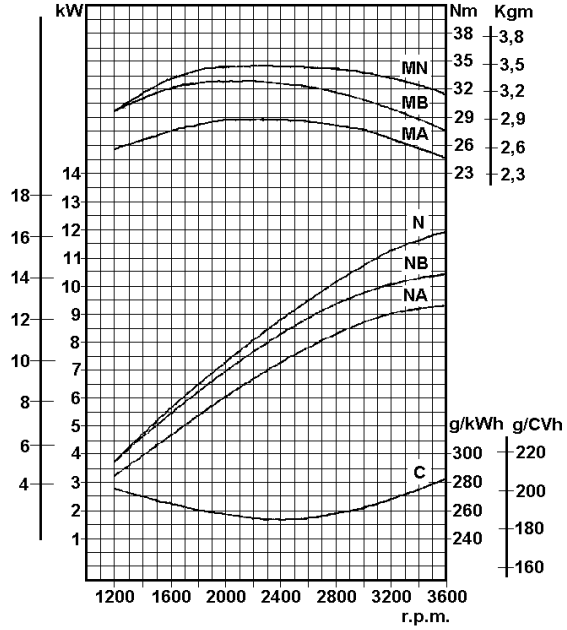
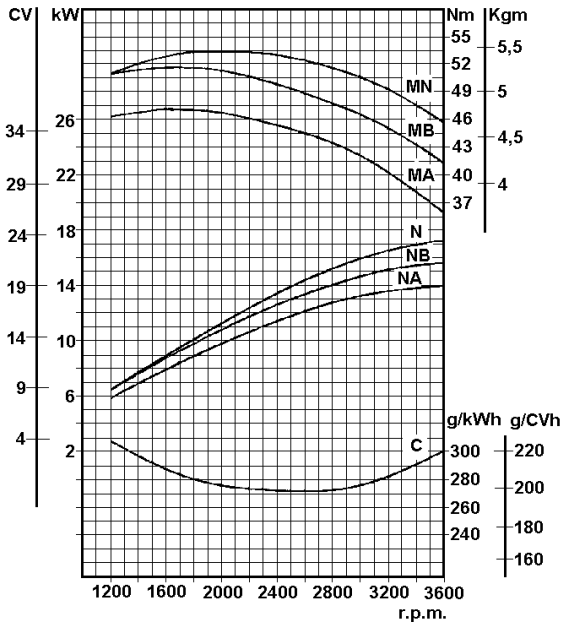


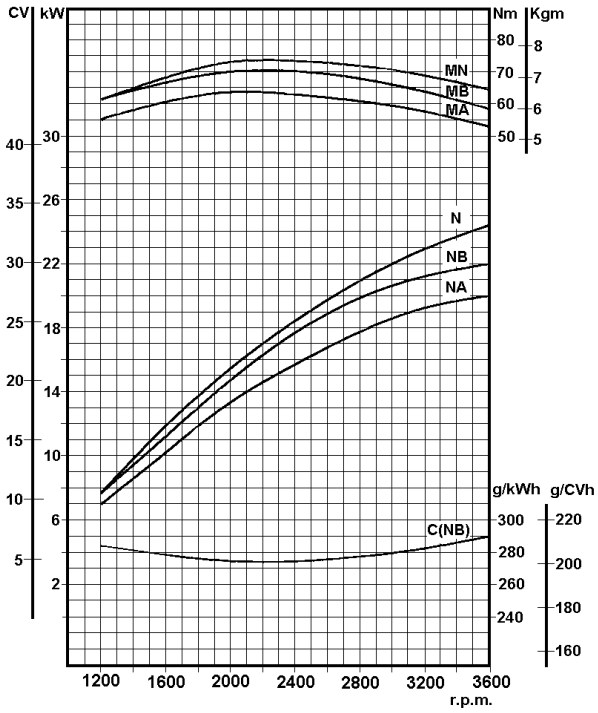
LDW 903



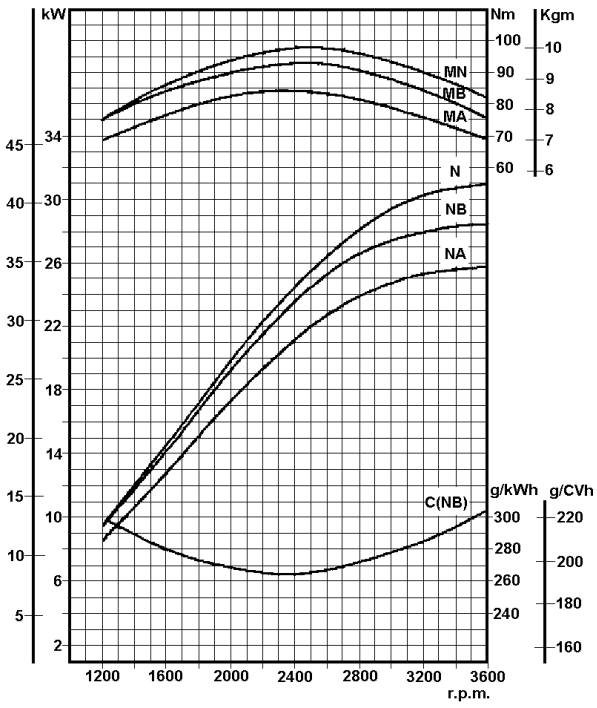
N - 80/1269/CEE- ISO 1585, Gross automotive rating- intermittent operation with variable speed and variable load.
NB- ISO 3046/1-IFN - Maximum intermittent rating with no overload capacity; operation with constant speed and variable load.
NA- ISO 3046/1-ICXN- Continuous rating with 10% intermittent overload allowed; operation with constant speed and constant load.
M(X)- Torque at N, NB and NA ratings respectively.
C- Specific fuel consumption at NB rating.
Standard Rating Conditions: 25°C, 100kPa Total Barometric Pressure, 30% Relative Humidity.
Standard Production Power Tolerance = +/- 5%
Standard/ General Derations: 2% per 5°C increase in temperature over 25°C; 1% per 100m over mean sea level

POWER, TORQUE AND SPECIFIC FUEL CONSUMPTION CURVES
LDW 1204 FOCS and LDW 1204/T FOCS

LDW 1204



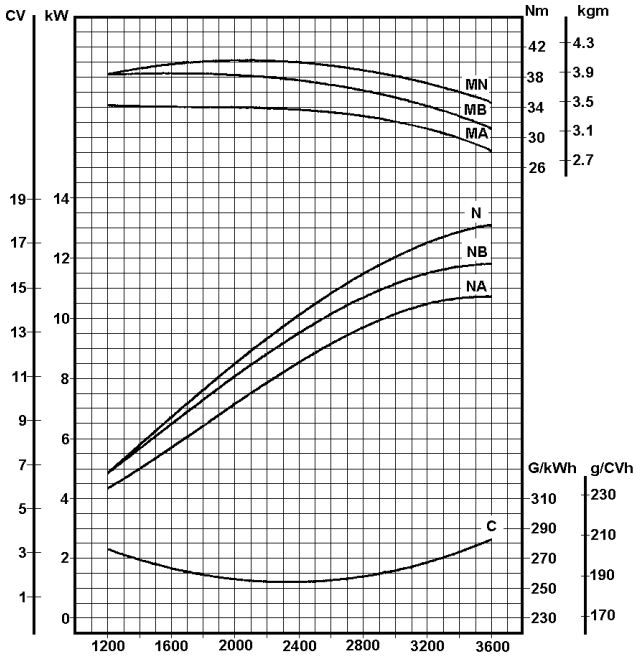
LDW 1204/T



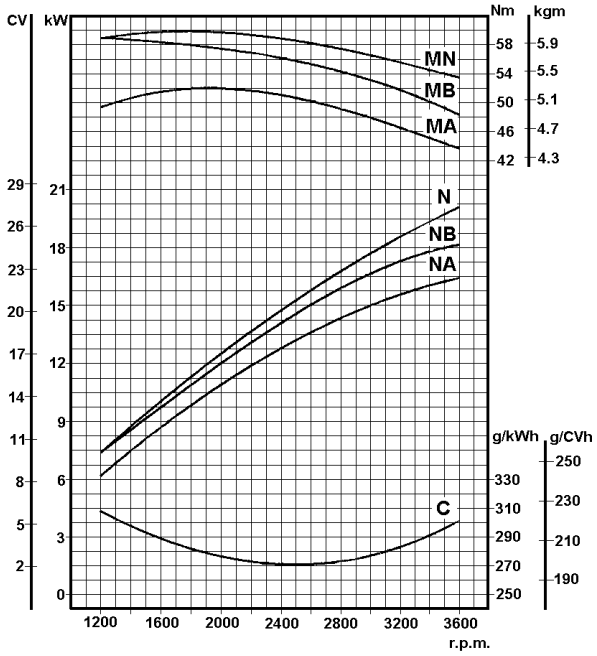
N - 80/1269/CEE- ISO 1585, Gross automotive rating- intermittent operation with variable speed and variable load.
NB- ISO 3046/1-IFN - Maximum intermittent rating with no overload capacity; operation with constant speed and variable load.
NA- ISO 3046/1-ICXN- Continuous rating with 10% intermittent overload allowed; operation with constant speed and constant load.
M(X)- Torque at N, NB and NA ratings respectively.
C- Specific fuel consumption at NB rating.
Standard Rating Conditions: 25°C, 100kPa Total Barometric Pressure, 30% Relative Humidity.
Standard Production Power Tolerance = +/- 5%
Standard/ General Derations: 2% per 5°C increase in temperature over 25°C; 1% per 100m over mean sea level

POWER, TORQUE AND SPECIFIC FUEL CONSUMPTION CURVES
LDW 702 FOCS, LDW 1003 FOCS, LDW 1404 FOCS

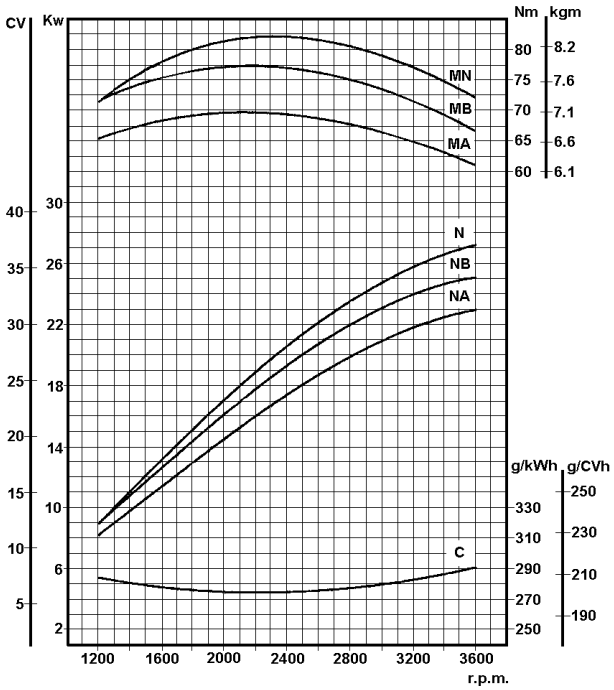
LDW 702



LDW 1003



LDW 1404



N - 80/1269/CEE- ISO 1585, Gross automotive rating- intermittent operation with variable speed and variable load.
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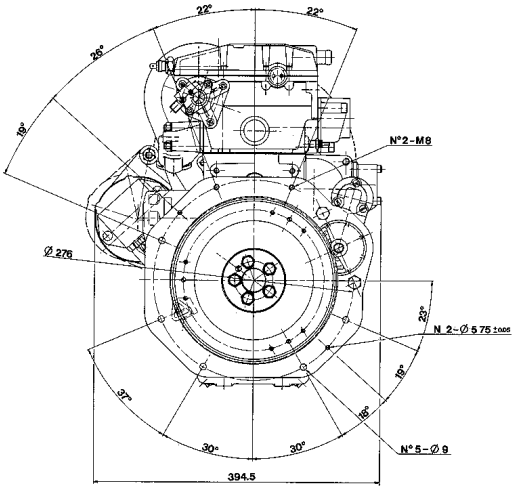
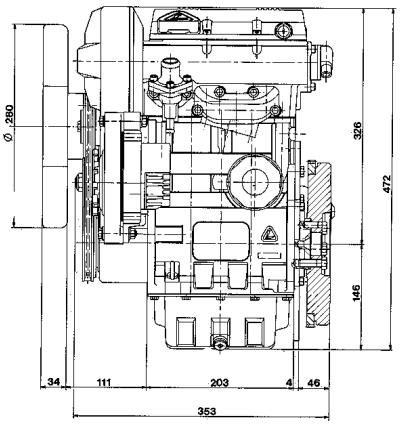
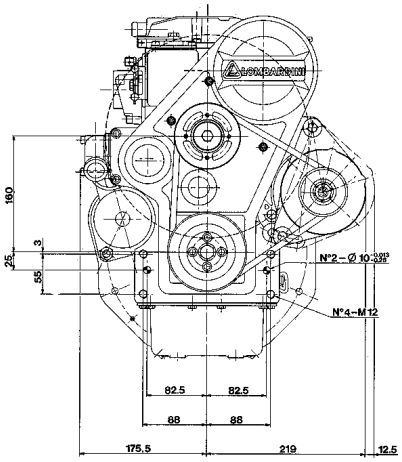
NA- ISO 3046/1-ICXN- Continuous rating with 10% intermittent overload allowed; operation with constant speed and constant load.
M(X)- Torque at N, NB and NA ratings respectively.
C- Specific fuel consumption at NB rating.
Standard Rating Conditions: 25°C, 100kPa Total Barometric Pressure, 30% Relative Humidity.
Standard Production Power Tolerance = +/- 5%
Standard/ General Derations: 2% per 5°C increase in temperature over 25°C; 1% per 100m over mean sea level

GENERAL ENGINEERING DRAWINGS- LDW 502 FOCS, LDW 602 FOCS, LDW 903 FOCS

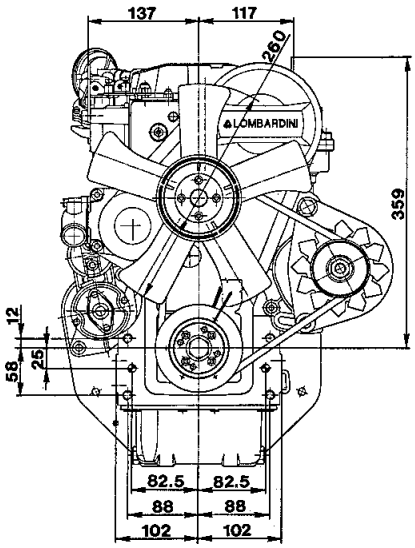
LDW 502

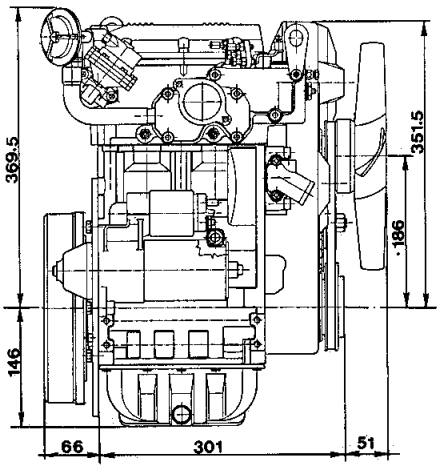


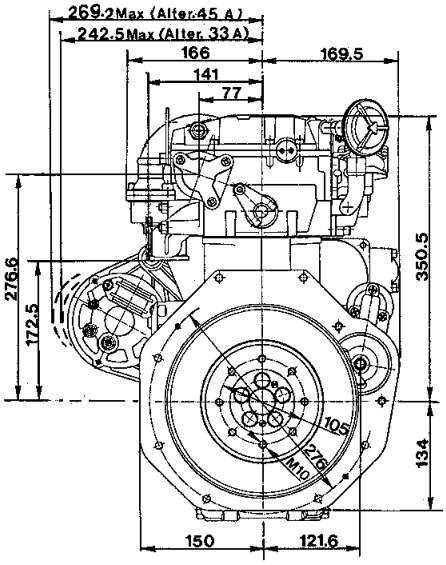




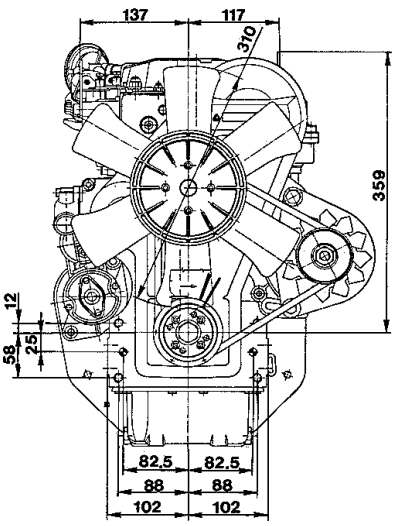
LDW 602

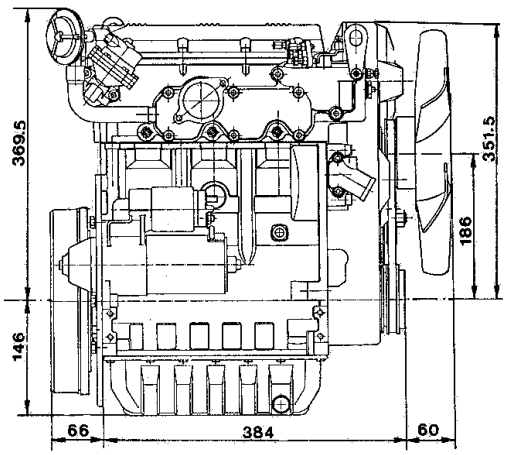


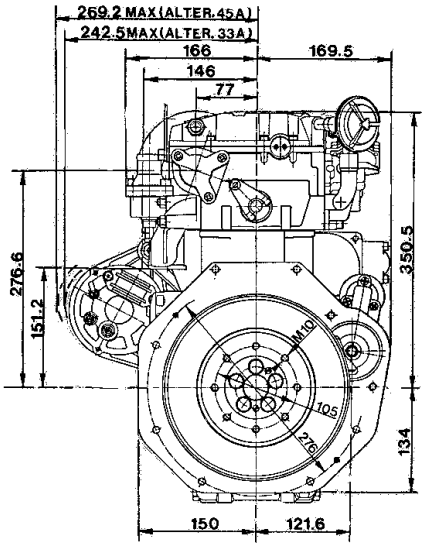




LDW 903

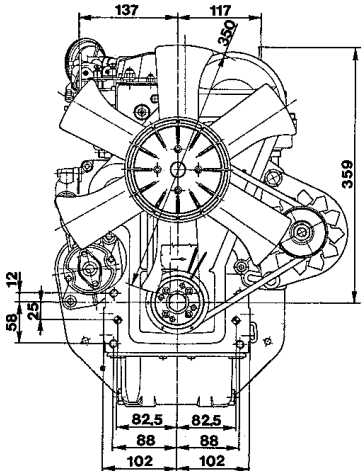


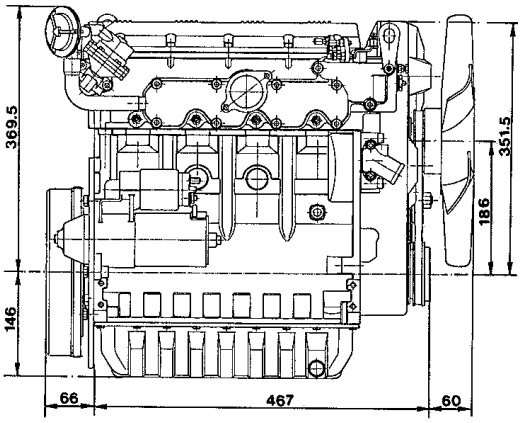


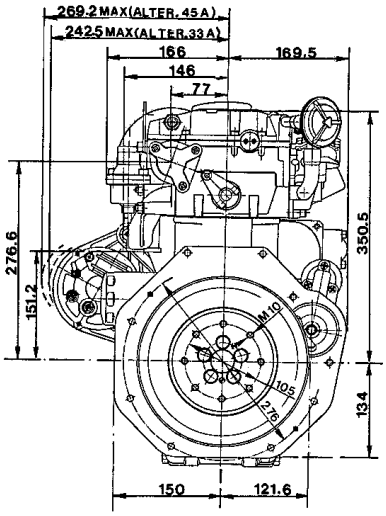


GENERAL ENGINEERING DRAWINGS- LDW 1204 FOCS, LDW 1204/T FOCS

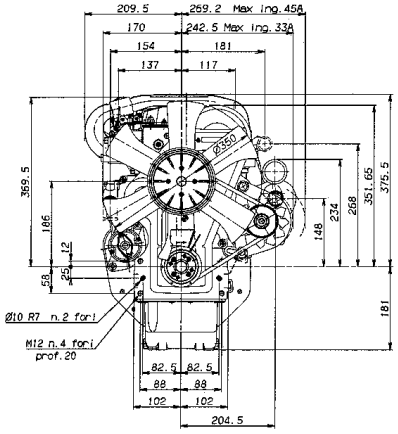
LDW 1204

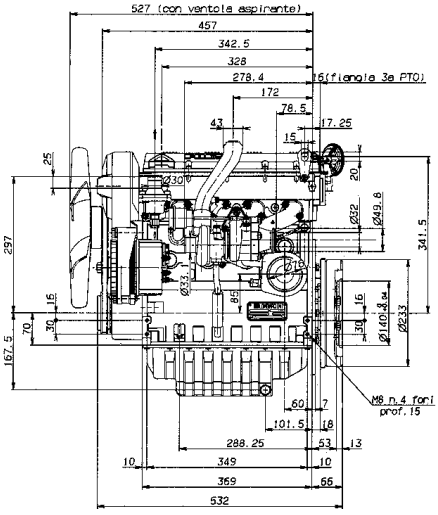


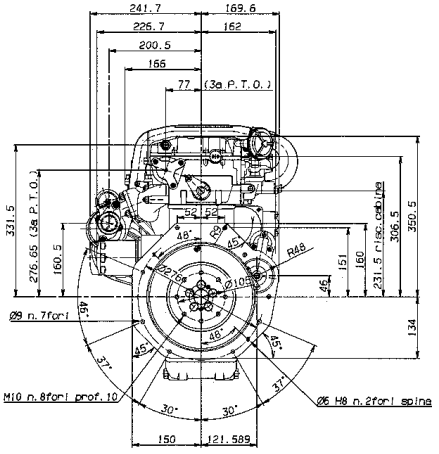




LDW 1204/T

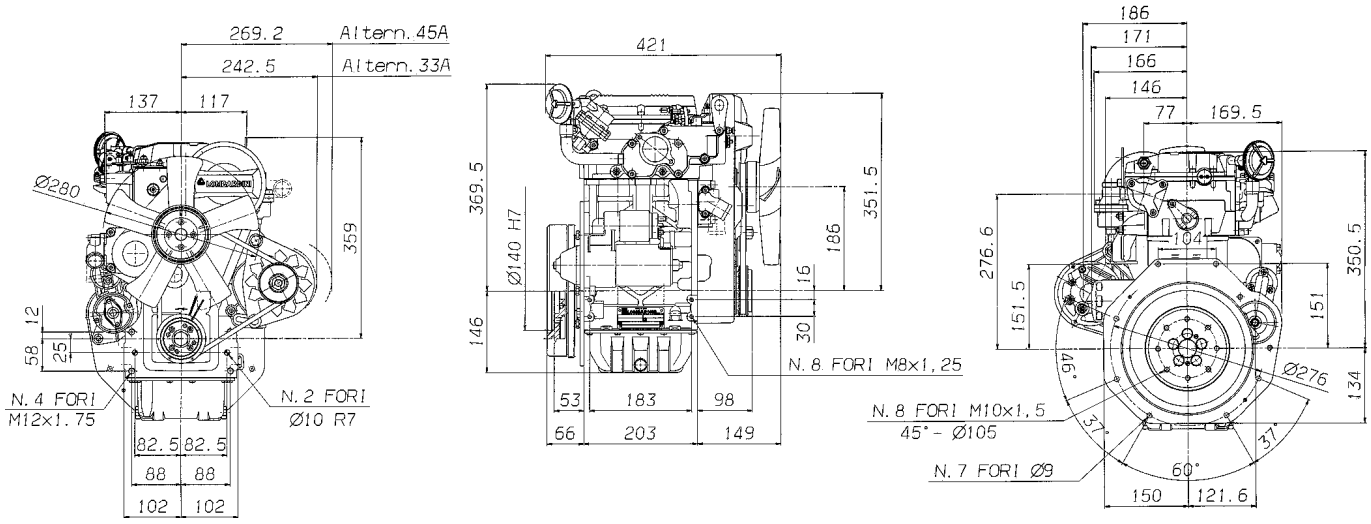




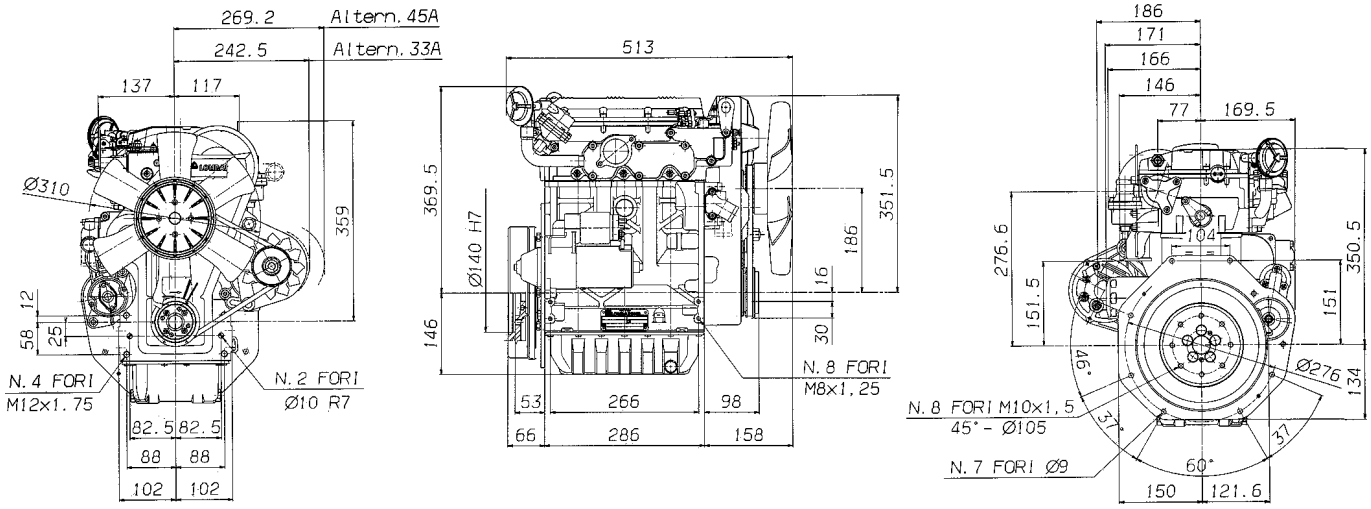


GENERAL ENGINEERING DRAWINGS- LDW 702 FOCS, LDW 1003 FOCS, LDW 1404 FOCS

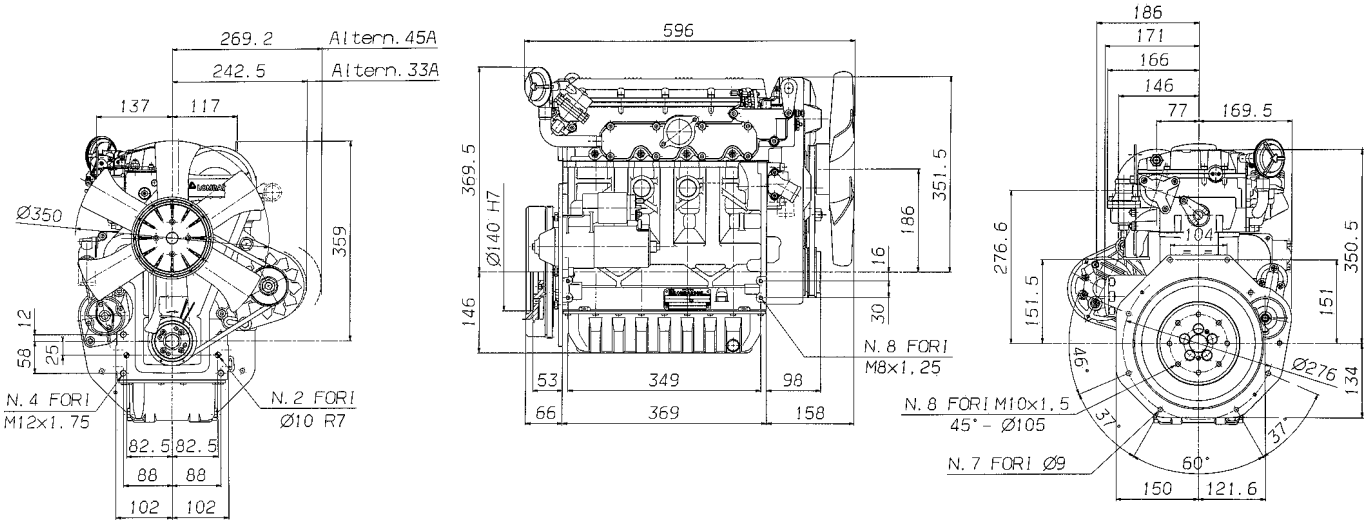
LDW 702



LDW 1003



LDW 1404



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

LDW- FOCS SERIES MAINTENANCE SCHEDULE

MAINTENANCE OPERATION	MAINTENANCE INTERVAL						
	10 hours or DAILY	50 hours	125 hours	250 hours	500 hours	1000 hours	2500 hours
OIL LEVEL CHECK (D)	▪						
COOLANT LEVEL CHECK (D)	▪						
FAN/ ALTERNATOR BELT INSPECTION (•)	▪						
AIR FILTER ELEMENT CHECK (DRY TYPE) (*)	see note						
AIR FILTER CHECK (OIL BATH TYPE) (**)	▪						
RADIATOR CORE INSPECTION (⦿)	▪						
FLUID LEAK INSPECTION- GENERAL (•)	▪						
SAFETY GUARD INSPECTION (•)	▪						
OIL REPLACEMENT- INITIAL ONLY-(see RECOMMENDED OIL TYPE)		▪					
OIL FILTER REPLACEMENT - INITIAL ONLY		▪					
OIL REPLACEMENT- (see RECOMMENDED OIL TYPE)			▪				
OIL FILTER REPLACEMENT				▪			
FUEL FILTER REPLACEMENT				▪			
COOLANT HOSE INSPECTION				▪			
FAN/ ALTERNATOR BELT TENSION ADJUSTMENT				▪			
VALVE ADJUSTMENT					▪		
FAN/ ALTERNATOR BELT REPLACEMENT					▪		
FUEL INJECTION SYSTEM ADJUSTMENT					▪		
CLEAN FUEL TANK (⦿)						▪	
COOLANT REPLACEMENT (***)						▪	
REPLACE TIMING BELT							▪

(D) Add fluid(s) as required
(•) After inspection, adjust, repair or replace as required
(⦿) Clean as often as required
(*) Replace air filter after air filter restriction switch indication or one(1) year. Lombardini does not recommend the removal of air filter elements for purposes of inspection.
(**) Service oil bath filter element (upper and lower) as required. Replace reservoir oil as required. NOTE: In dusty conditions, service the oil bath air filter every four(4) hours.
(***) Replace coolant every 1000 hours or 2 years

NOTES: 1. USE ONLY GENUINE LOMBARDINI REPLACEMENT PARTS.
2. USE ONLY LOMBARDINI APPROVED FLUIDS.

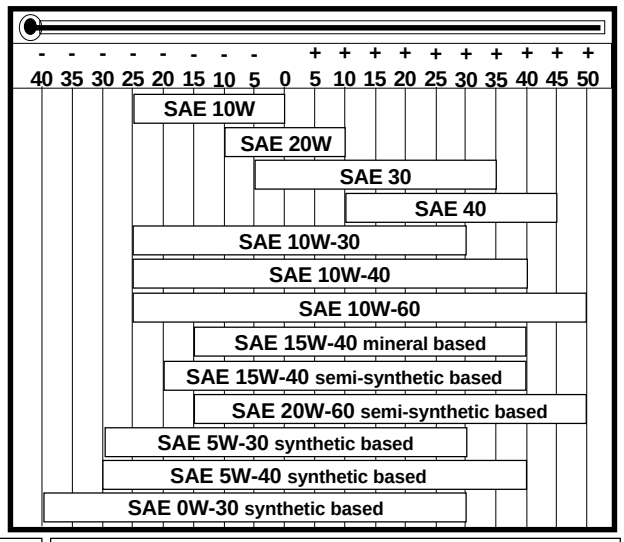
The engine could be damaged if allowed to operate with insufficient oil. It is also dangerous to add too much oil as its combustion could sharply increase the rotation speed.
Use a suitable oil in order to protect the engine.
The lubrication oil influences the performances and life of the engine in an incredible way.
Use of an inferior quality oil or failure to regularly change the oil will increase the risk of piston seizure, may make the compression rings jam and will lead to rapid wear on the cylinder liner, the bearings and all other moving parts. Engine life will also be notably reduced.
Oil viscosity must suit the ambient temperature in which the engine operates.

Old oil can cause skin cancer if repeatedly left in contact with the skin and for long periods of time. If contact with the oil is inevitable, you are advised to thoroughly wash your hands with soap and water as soon as possible.
Appropriate protective gloves etc should be wore during this operation.
Old oil is highly polluting and must be disposed of in the correct way. Do not litter.

RECOMMENDED OIL

AGIP SINT 2000 5W40 specification API SJ/CF ACEA A3-96 B3-96 MIL-L-46152 D/E.
ESSO ULTRA 10W40 specification API SJ/CF ACEA A3-96 MIL-L-46152 D/E.
In countries where AGIP and ESSO products are not available, use API SJ/CF oil for gasoline-fuelled engines or oil that complies with military specification MIL-L-46152 D/E.

GRADE



OIL SUPPLY (liters) 502 - 602 - 702
Standard oil sump
filter included 1.6
filter excluded 1.5

OIL SUPPLY (liters) 903 - 1003
Standard oil sump
filter included 2.4
filter excluded 2.3

OIL SUPPLY (liters) 1204 -1404
Standard oil sump
filter included 3.2
filter excluded 3.0

OIL SUPPLY (liters) 1204/T
Standard oil sump
filter included 4.3
filter excluded 4.1

ACEA SEQUENCES

A = Gasoline (Petrol)
B = Light Diesel fuels
E = Heavy Diesel fuels

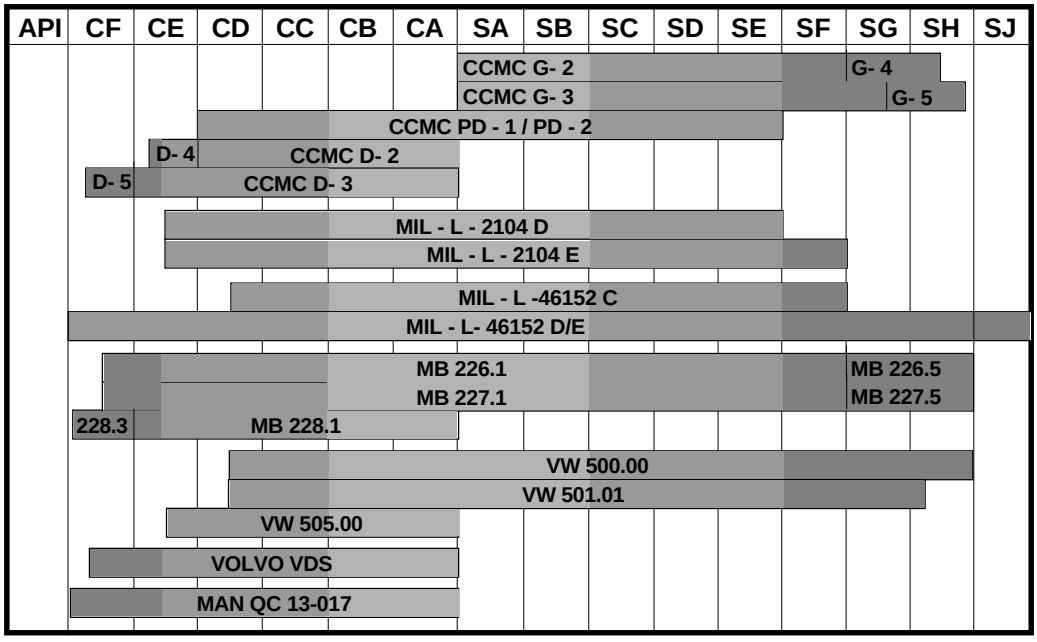
Required levels :

A1-96
A2-96
A3-96

B1-96
B2-96
B3-96

E1-96
E2-96
E3-96

DIESEL	BENZINA - ESSENCE - PETROL BENZIN - GASOLINA -



DIESEL FUEL SPECIFICATIONS

Diesel fuel must be clean, fresh, meet Lombardini fuel specifications and be sourced from a known and reputable supplier. Clean, fresh and properly specified diesel fuel will provide assurances of maximum engine performance and maximum fuel injection system longevity. The use of out-of-spec, dirty or questionable quality diesel fuel will result in engine performance and start ability problems as well as reductions in engine and fuel injection system life.

Lombardini diesel engines are designed to operate on No. 2 diesel fuel. However, some geographical areas, by virtue of cold winter temperatures, change the diesel fuel supply depot to No. 1 diesel fuel in winter months. No. 2 diesel fuel provides maximum viscosity and lubricity but can have “waxing” problems at lower temperature. Lombardini expressly recommends the use of No. 2 diesel fuels when temperatures are above -10°C (14°F). Lombardini recommends that No. 1 diesel fuel be used when temperatures are at or below -10°C (14°F). Lombardini allows the use of either EPA- High Sulfur, off-highway diesel fuel or EPA- Low Sulfur, on-highway fuel for non-CARB certified engines. CARB certified engines must consume only EPA- low sulfur diesel fuels conforming to EPA 40 CFR 86-113-94. For general non-CARB certified engines, Lombardini highly recommends that either low sulfur or high sulfur fuel be used on a continuous basis. Mixing the usage of low sulfur and high sulfur fuels can cause complications within the fuel injection system and thus is not recommended.

Lombardini does not recommend the use of “heating oil”, blended fuel/ waste engine oil, or low grade diesel fuel of any kind. The use of aviation fuels- JP4, JP5 or JP8 must be approved on an application basis and is not recommended for broad range commercial applications.

EPA FUEL SPECIFICATIONS (No. 2 DIESEL FUEL):

	ASTM TEST	EPA 40CFR 86.113-90 (OFF-HIGHWAY FUEL)	EPA 40CFR 86.113-94 (ON-HIGHWAY FUEL)
CETANE NUMBER	D613	42-50	40-48
DISTILLATION RANGE			
BP	D86	340-400°F (171.1-204.4°C)	340-400°F (171.1-204.4°C)
10% point	D86	400-460°F (204.4-237.8°C)	400-460°F (204.4-237.8°C)
50% point	D86	470-540°F (243.3-282.2°C)	470-540°F (243.3-282.2°C)
90% point	D86	550-610°F (287.8-321.1°C)	560-630°F (287.8-321.1°C)
EP	D86	580-660°F (304.4-348.9°C)	610-690°F (304.4-348.9°C)
GRAVITY (API)	D287	33-37	33-37
TOTAL SULFUR (pct.)	D129 D2622	0.2-0.5	0.03-0.05
HYDROCARBONS			
AROMATICS (min. pct.)	D1319	27	27
PARAFFINS, OLEFINS, NAPHTHENES (pct.)	D1319	73	73
FLASHPOINT	D93	130°F (54.4°C)	130°F (54.4°C)
VISCOSITY (CSt)	D445	2.0-3.2	2.0-3.2

NOTE: BY LAW, EPA 40CFR 86.113-90 FUEL MUST BE DYED RED.

FUEL QUALITY/ STORAGE:
No. 1 and No. 2 Diesel fuel degrades with time. No. 2 diesel fuel has a storage life of approximately one(1) year. No. 1 diesel fuel has a maximum storage life of two(2) years. Further, storage of diesel fuel in contaminated storage tanks can lead to excessive impurities within the stored fuel. As such, aged or contaminated diesel fuel should not be consumed by Lombardini diesel engines. Aside from the specifications listed above, fuel measured to have total insolubles > 1mg/100mg, organic matter > 1mg/100ml or rust/mineral matter > 2mg/ml should not be consumed by Lombardini diesel engines.

ANTI-FREEZE / COOLANT SPECIFICATIONS/ DETAILS- FOCS SERIES

Ethylene Glycol based Anti-freeze / coolant usage is required for all Lombardini LDW-FOCS series engines. Never operate a LDW-FOCS engine with the cooling system filled with water only. The purpose of the anti-freeze/coolant is three-fold. First the anti-freeze/coolant mixture prevents or reduces the potential for corrosion within the cooling system. Secondly, the anti-freeze/ coolant increases the boiling point of the cooling fluid, reducing the potential for localized boiling within the engine and engine overheat in general. Lastly, the anti-freeze/coolant reduces the freezing point of the engine coolant, thereby reducing or preventing potential engine damage caused by freezing.

Many different brands and types of anti-freeze are available in the market. Some anti-freeze/coolants are designed exclusively for automotive type cooling systems with aluminum cooling system components. Other anti-freeze/coolants are designed exclusively for use within heavy-duty, predominately cast iron cooling systems and require that the coolant solution be “charged” with a Supplemental Coolant Additive (SCA). Other anti-freeze solutions are designed for long life and are sometimes designated “permanent”.

Lombardini recommends only those anti-freeze/coolants which are ethylene glycol based and designed to protect aluminum coolant components- thus, automotive anti-freeze/coolant. Long life anti-freeze/coolants may be used so long as the anti-freeze/coolant is changed at least every two(2) years as is required by the Lombardini maintenance schedule. Lombardini does not recommend the use of low silicate heavy duty anti-freeze/coolants which may or may not require the use of SCA’s. The following provides guidelines for the selection of acceptable anti-freeze/coolants for LDW-FOCS series diesel engines.

ANTI-FREEZE/COOLANT CONCENTRATION

Lombardini recommends that the minimum anti-freeze/coolant concentration be 30% when mixed with distilled water. Concentrations below 30% will not provide adequate corrosion protection. Lombardini further recommends that the maximum allowable anti-freeze/coolant concentration be 60% when mixed with distilled water. Concentrations of anti-freeze/coolant in excess of 60% provide no appreciable additional freeze protection and can actually reduce the heat rejection capability of the cooling system. As such, Lombardini recommends that an anti-freeze / coolant mixture of 50% anti-freeze/coolant and 50% distilled water be used for most general applications. In general terms the freezing points of anti-freeze/coolant solutions (ethylene glycol based) with respect to concentration is 30%/ -15°C(5°F); 40%/ -24°C(-12°F); 50%/ -37°C(-34°F); 60%/ -52°C(-62°F). Please refer to the details regarding freezing points as supplied from your anti-freeze/coolant supplier for more exact information.

WATER SPECIFICATIONS

Lombardini recommends that the engine cooling fluid solution be made up of the ethylene glycol based anti-freeze/coolant and distilled water. Further, we realize that the use of distilled water is not always practical. The quality of the base water does play a large role in the overall chemical composition of the coolant solution and the corrosion prevention characteristics of the solution. As such, tap water may be used as long as the water meets the following specifications with reference to SAE j1941:

PROPERTY	SPECIFICATION	TEST METHOD
Total Solids (max.)	340ppm	ASTM D1888
Total Hardness (max. $CaCO_3$)	170ppm	ASTM D1126
Chloride (max.)	40ppm	ASTM D512
Sulfate (max. SO_4)	100ppm	ASTM D516
pH	5.5-9.0	ASTM 1293

ANTI-FREEZE COOLANT MINIMUM RECOMMENDATIONS/ SPECIFICATIONS

Lombardini recommends that only automotive type anti-freeze/coolants be used in LDW-FOCS series diesel engines. These anti-freeze/coolants are typically “High Silicate” , although not always, and are designed to prevent corrosion in cooling systems with aluminum components. The chosen coolant should meet or exceed ASTM 3306 and SAE j1034. Further, the chosen anti-freeze/coolant should pass ASTM D4340, ASTM D1384 and ASTM D2570 corrosion tests as detailed within SAE j1034.

NOTE: Many brands/ products meet the specifications presented above and may be used within Lombardini LDW-FOCS series diesel engines. The engine owner is responsible for determining the suitability of any given anti-freeze/coolant to the minimum specifications provided. Failure to follow the above coolant guidelines may impact the engine warranty.

DRIVING TORQUES FOR STANDARD SCREWS

DENOMINATION						
Diameter x pitch (mm)	R ³ 800 N/mm²		R ³ 1000 N/mm²		R ³ 1200 N/mm²	
	Nm	Kgm	Nm	Kgm	Nm	Kgm
4x0.70	3.6	0.37	5.1	0.52	6	0.62
5x0.80	7	0.72	9.9	1.01	11.9	1.22
6x1.00	12	1.23	17	1.73	20.4	2.08
7x1.00	19.8	2.02	27.8	2.84	33	3.40
8x1.25	29.6	3.02	41.6	4.25	50	5.10
9x1.25	38	3.88	53.4	5.45	64.2	6.55
10x1.50	52.5	5.36	73.8	7.54	88.7	9.05
13x1.75	89	9.09	125	12.80	150	15.30
14x2.00	135	13.80	190	19.40	228	23.30
16x2.00	205	21.00	289	29.50	347	35.40
18x2.50	257	26.30	362	37.00	435	44.40
20x2.50	358	36.60	504	51.50	605	61.80
22x2.50	435	44.40	611	62.40	734	74.90
24x3.00	557	56.90	784	80.00	940	96.00

SEALANT and THREAD LOCK LOCATIONS/ DETAILS

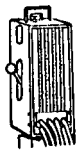
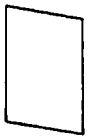
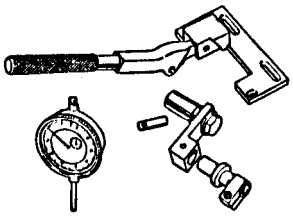
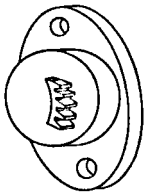
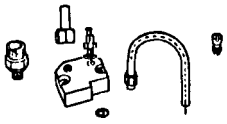
LOCATION	DETAIL	SEALANT / THREAD LOCK (LOCTITE BRAND)
Valve / Rocker Cover	12mm Crankcase Vent Tube	638
Oil Filter Nipple	M20x1.5 Hollow Nipple	601
Camshaft Bearing Retainer Bolts	M6	270
Timing Belt Idler Stud to Crankcase	M10	601
Crankcase	M12x1.5 Plug	242
Cylinder Head	18mm Plug	510
Cylinder Head	M6x1.0 Stud	601
Crankcase and Cylinder Head	Welch Plugs (30mm)	510

CRITICAL TORQUE SPECIFICATIONS			
POSITION/ LOCATION	Page No. Ref.	Diameter/ Pitch (mm)	TORQUE (Nm)
Injection Pump Control Rod (Rack Adjustment)	78	M3 (special)	1.1
Injection Pump Control Rod to Unit Injector Rack Bolt	34	M3 (special)	1.2
Fuel Rail	34	M4x0.7	4
Connecting Rod (***)	44	M8x1.00	40
Piston Cooling Jet (LDW 1204/T)		M8X1.5	12
Glow Plugs		M12x1.25	25
Valve / Rocker Cover	33	M6x1.00	9
Main Bearing Cap	47	M10	60
Oil Pan	40	M6	10
Camshaft Roller Bearing Retainer		M6	10
Glow Plug Wire Nut		M5x0.8	5
Timing Belt Idler	28	M10	40
Stop Lever Nut		M8x1.25	8
Unit Injector Retainer Nut	30	M8	20 (*)
Rocker Arm Support	35	M10	40
Fuel Pump Eccentric	34	M10x1.25	80
Oil Seal Support (Flywheel Side)		M6	12
Pre-chamber Ring Nut	40	M30x1.5	(**)
Governor Fork Pivot		M6x1.00	7
Crankshaft Pulley (V)	26	M16x1.5 (Left Hand)	360
Camshaft Timing Pulley	27	M10x1.25	80
Oil Pressure Switch		M12x1.5	25
Oil Pan Plug		M12x1.5	40
Cylinder Head	46	SEE MANUAL FOR DETAILS	
Flywheel	26	M10x1.5	80

(*) Torque the unit injector retaining nuts alternately in 5 Nm steps

(**) Torque the pre-chamber ring nut to 100 Nm first, then torque to 180 Nm.

(***) Torque aluminum connecting rods to 35 Nm.

SPECIAL TOOLS	DESCRIPTION	PART No.
	Fuel delivery equalization tool. Allows the adjustment of individual unit injector fuel delivery.	7107-1460-090
	Pre-chamber removal tool.	7107-1460-030
	Static timing tool	7107-1460-024
	Main bearing cap lateral seal installation tool.	7107-1460-053
	Unit injector ring nut tool.	7107-1460-029
	Pre-chamber ring nut tool.	7107-1460-027
	Pre-chamber index.	7107-1460-031
	Union for static timing adjustment/ testing.	7107-1460-028
	Valve guide seal installation tool.	7107-1460-047
	T.D.C. determination fixture.	7107-1460-048
	Timing Belt tension tool.	7107-1460-049
	Flywheel/ Ring gear engine locking tool.	7107-1460-051
	Static timing kit for “low pressure” testing/ adjustment.	7107-1460-074 7107-1460-056 (See pg. 55 for details)