CNG NEF SERIES

Vehicle application

N60

N60 ENT G

Technical and Repair manual

Part 1
F4B ENGINES

PREFACE TO USER'S GUIDELINE MANUAL

Section 1 describes the F4B engine illustrating its features and working in general.

Section 2 describes the type of fuel feed.

Section 3 relates to the specific duty and is divided in four separate parts:

1. Mechanical part, related to the engine overhaul, limited to those components with different characteristics based on the relating specific duty.
2. Electrical part, concerning wiring harness, electrical and electronic equipment with different characteristics based on the relating specific duty.
3. Maintenance planning and specific overhaul.
4. Troubleshooting part dedicated to the operators who, being entitled to provide technical assistance, shall have simple and direct instructions to identify the cause of the major inconveniences.

Sections 4 and 5 illustrate the overhaul operations of the engine overhaul on stand and the necessary equipment to execute such operations.

Installation general prescriptions are reported within the appendix.

The appendix reports general safety prescriptions to be followed by all operators whether being in-charge of installation or maintenance, in order to avoid serious injury.

SECTION 1

General specifications

CORRESPONDENCE BETWEEN TECHNICAL CODE AND COMMERCIAL CODE

Technical Code	Commercial Code
F4BE0641A*G102	N60 ENT G
F4BE0641A*G103	N60 ENT G
F4BE0641A*G105	N60 ENT G

LUBRICATION

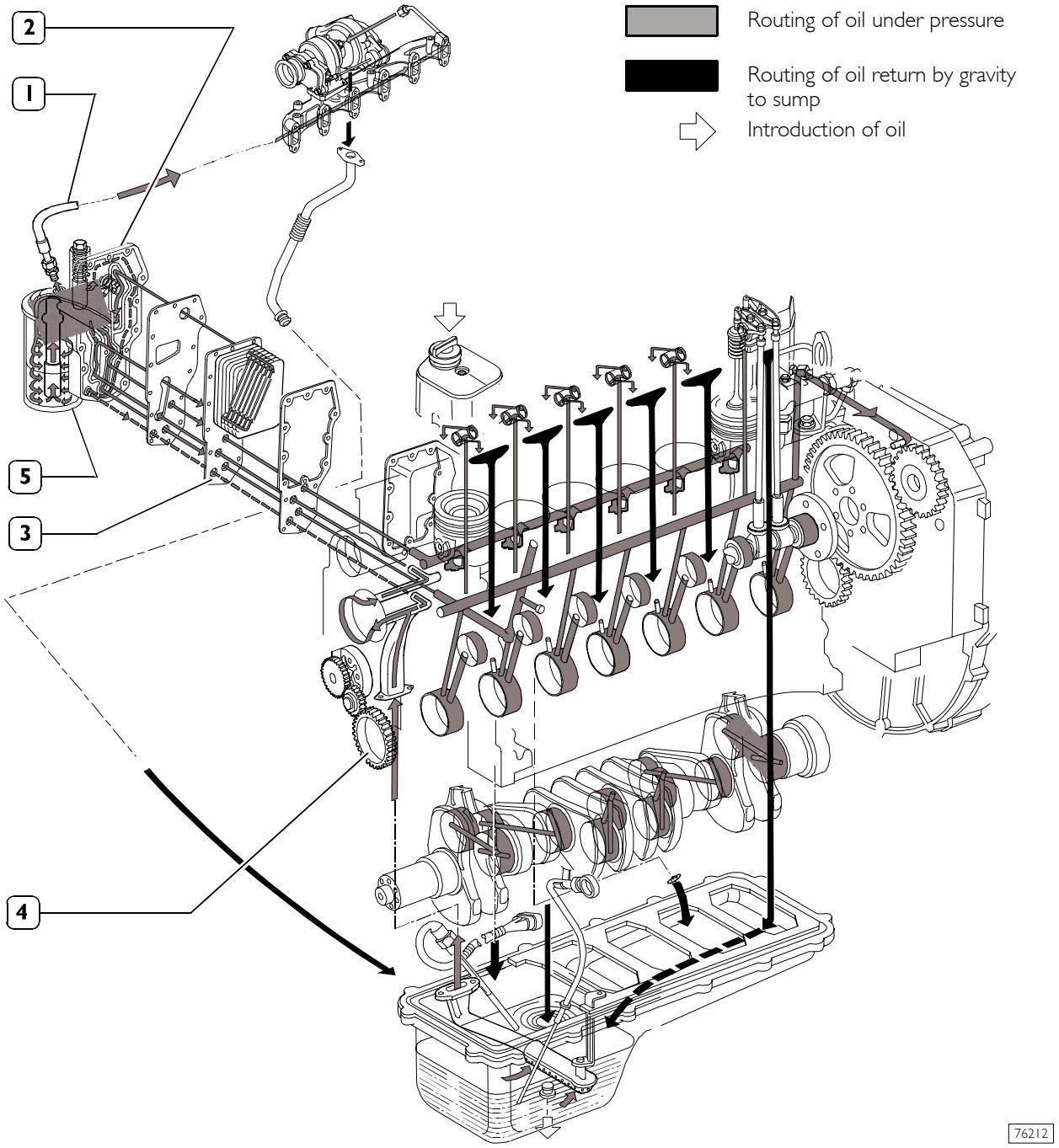
Lubrication by forced circulation is achieved through oil rotary expansion pump, placed in the front part of the basement, driven by the straight-tooth gear splined to the shaft's bar hold.

From the pan, the lubrication oil flows to the driving shaft, to the camshaft and to the valve drive.

Lubrication involves the heat exchanger (2,3), the turboblower for turbocompressed versions, and for any compressed air system.

All these components may often vary according to the specific duty.

Figure 1 (Demonstrative)

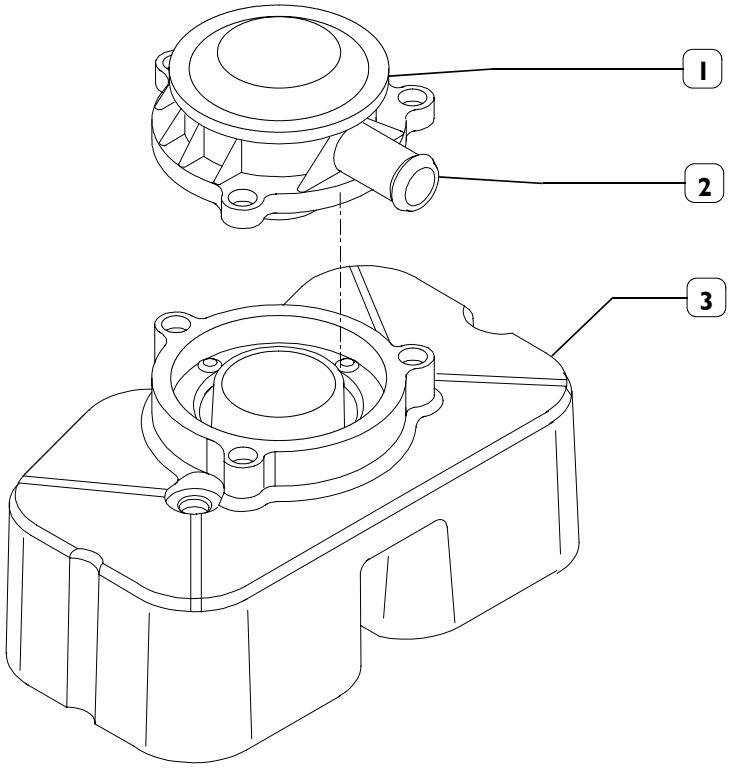


LUBRICATION SYSTEM LAYOUT

1. Lubrication oil pipe to supercharger - 2. Heat exchanger body - 3. Heat exchanger - 4. Oil rotary expansion pump - 5. Oil filter.

OIL VAPOUR RECIRCULATING SYSTEM

Figure 2



1. Valve - 2. Breather pipe - 3. Tappet Cap.

On the tappet cap (3) there is a valve (1) whose duty is to condense oil vapour inducing these to fall down because of gravity, to the Tappet cap underneath.

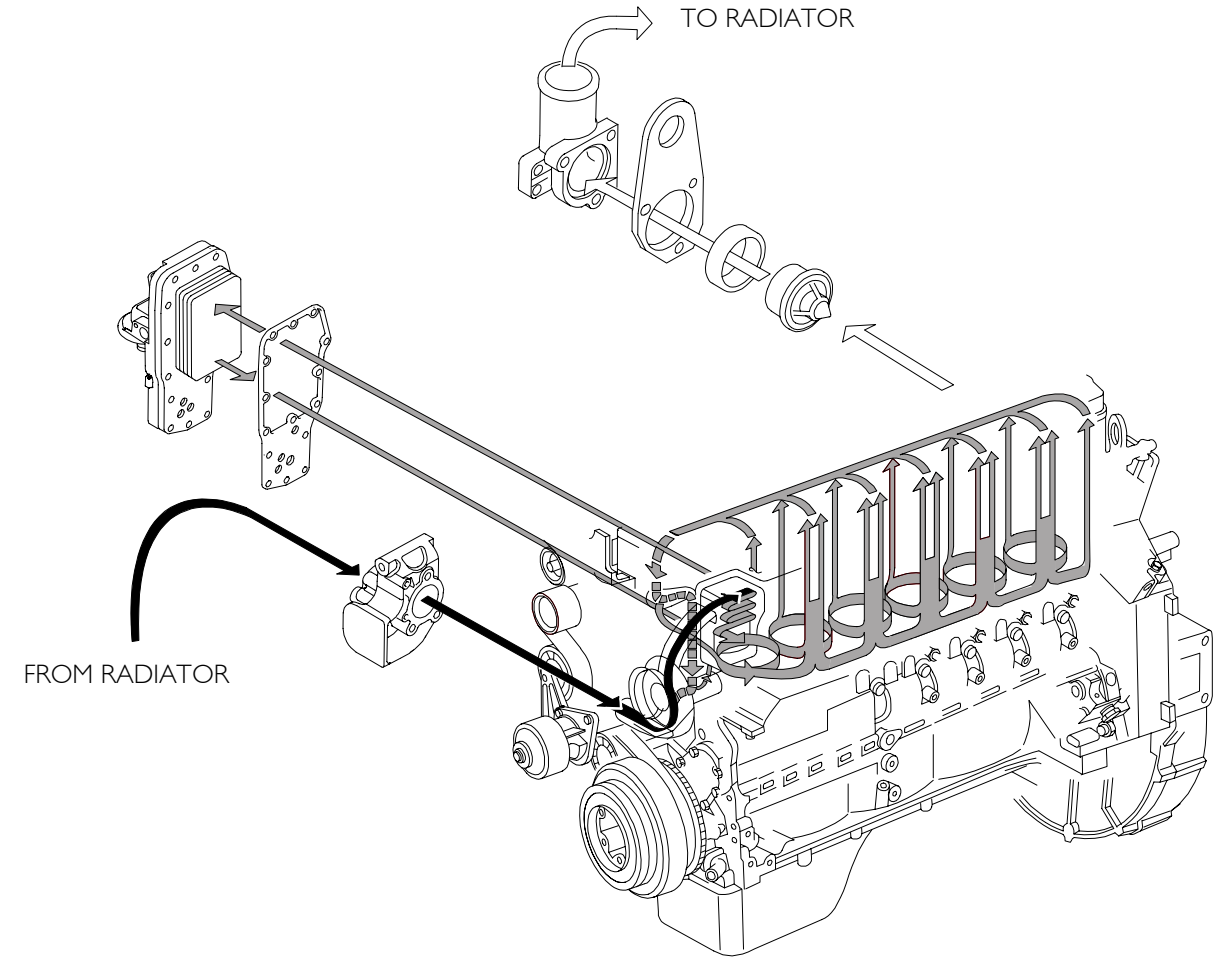
The remaining non-condensed vapours shall be properly conveyed through the breather pipe (2), by suction as an example (connection towards these vapours shall be designed by the Engineer).

COOLING SYSTEM

The engine cooling system, closed circuit forced circulation type, generally incorporates the following components:

- ❑ Expansion tank; placement, shape and dimensions are subject to change according to the engine's equipment.
- ❑ Radiator, which has the duty to dissipate the heat subtracted to the engine by the cooling liquid. Also this component will have specific peculiarities based on the equipment developed, both for what concerns the placement and the dimensions.
- ❑ Visc pusher fan, having the duty to increase the heat dissipating power of the radiator. This component as well will be specifically equipped based on the engine's development.
- ❑ Heat exchanger to cool the lubrication oil: even this component is part of the engine's specific equipment.
- ❑ Centrifugal water pump, placed in the front part of the engine block.
- ❑ Thermostat regulating the circulation of the cooling liquid.
- ❑ The circuit may eventually be extended to the compressor, if this is included in the equipment.

Figure 3



Water coming out from thermostat

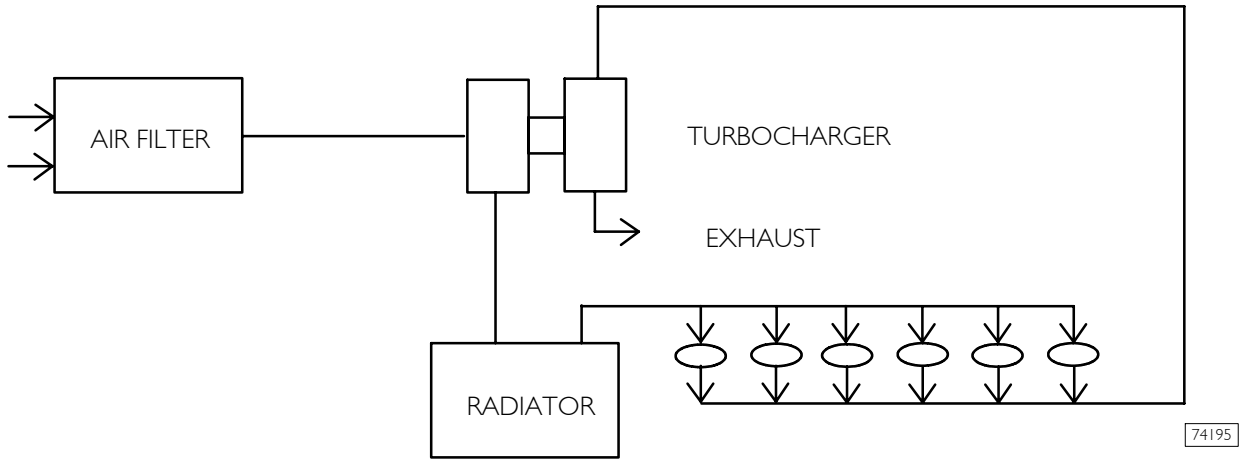
Water recirculating in engine

Water coming into pump

COOLING SYSTEM LAYOUT

AIR INDUCTION BOOST DIAGRAM

Figure 4



Description

The turbocharger is composed by the following main parts: one turbine, one transforming valve to regulate the boost feeding pressure , one main body and one compressor.

During engine working process, the exhaust emission flow through the body of the turbine, provoking the turbine disk wheel's rotation.

The compressor rotor, being connected by shaft to the turbine disk wheel, rotates as long as this last one rotates, compressing the sucked air through the air filter.

The above mentioned air is then cooled by the radiator and flown through the piston induction collector.

The turbocharger is equipped with a transforming valve to regulate the pressure , that is located on the exhaust collector before the turbine and connected by piping to the induction collector.

It's duty is to choke the exhaust of the emissions , releasing part of them directly to the exhaust tube when the boost feeding pressure, over the compressor, reaches the prescribed bar value.

The cooling process and the lubrication of the turbocharger and of the bearings is made by the oil of the engine.

SECTION 2

Fuel

CHEMICAL COMPOSITION OF NATURAL GAS (CNG)

Natural gas is a mixture of gases, mainly composed of methane gas, the percentage of which, as the one of the other components, may vary from each field. In gas of domestic production and imported gas as well, main characteristics are though included in an almost limited range of tolerance. Chemical characteristics of natural gas are determined throughout chromatographic analysis which enables to define the composition. Natural gas is a mixture of aliphatic saturated compounds called paraffin. In the one distributed in Italy, methane (CH_4) is found in percentages included in range between 83% and 99%. The other compounds are generally ethane, (C_2H_6), propane (C_3H_8), butane (C_4H_{10}), nitrogen (N_2), carbon dioxide (CO_2), and so on. The main chemical-physical characteristics of the domestic natural gas are reported in the table below.
Natural gas is colourless, odourless and is not toxic. The law prescribes that electronic systems to control ignition in methane engine are of "auto-adjusting" type, which means able to automatically modify ignition parameters in presence of gas with different content of methane.

GAS Indicative composition	Domestic %	Russian %	Dutch %	Algerian %
Methane	99.62	98.07	91.01	83.28
Ethane	0.06	0.60	3.70	7.68
Propane	0.02	0.22	0.88	2.05
Butane	0.01	0.09	0.28	0.78
Pentanes	-	0.01	0.07	0.21
Hexanes +	0.01	0.02	0.07	0.11
Carbon dioxide	0.02	0.11	1.11	0.19
Nitrogen	0.26	0.87	2.84	5.52
Helium	-	0.01	0.04	0.18

ADVANTAGES OF METHANE GAS UTILIZATION IN AUTOMOTIVE

ECOLOGIC

- ❑ Methane is well-known as the only alternative ecologic fuel really available.
- ❑ Methane utilization is relentlessly increasing as being the most reasonable and feasible alternative to electrical and hybrid vehicles.

TECHNICAL

- ❑ The engine "likes" methane.

STRATEGICAL

- ❑ Worldwide oil and natural gas availability is very high, and procurement sources are less subject to geographical and political risks.

ECONOMICAL

Motor advantages of methane gas utilization

The gaseous status and the high antiknock power make methane a suitable fuel for the feed of engines with firing control driven by high compression volumetric ratio. (up to 13:1).

The high octane value (120-130) confers to methane significant resistance to detonation, featuring the super fuels.

Due to the fuel initial purity and the absence of additives, combustion originates limited deposit formation and very small quantity of sulphurous products.

Moreover, the absence of condensation phenomenon along the combustion chamber ducts enables easy start.

Joint to with minor deposit accumulation, there is the possibility to use lubrication oil for a higher number of working hours.

The technology adopted brings forward the following **advantages**:

- ❑ it eliminates **particulate** emissions from original source, typical of diesel engines and absent in controlled fire engines;
- ❑ it reduces **gas** emissions (unburnt hydrocarbons HC, carbon oxide CO and nitrogen oxide NOx) to very low levels, lower than the limits prescribed for 2008. This reduction takes place into the three-way catalyser which, when the mixture is stoichiometric, eliminates pollution emissions of the engine, with over 90% efficiency;
- ❑ moreover, there are no emissions of superior hydrocarbons, such as benzene and derivatives;
- ❑ it reduces the emissions of **carbon dioxide**, thanks to the utilization of methane which, compared to diesel oil and gasoline, produces more water vapour and less carbon dioxide;
- ❑ it significantly reduces **noise**, as the engine has controlled firing.

Disadvantages of methane utilization in engines

Since gas, with the same energetic content, occupies higher volume than liquid fuels this involves the following:

less volumetric efficiency of the engine (in proportion to the volume of the gas delivered at induction);

Overall volume / cost / complexity of fuel storage system aboard the vehicle.

Lower engine efficiency compared to Diesel, but higher than gasoline feed engine.

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