

➤ **OPERATION AND MAINTENANCE RECOMMENDATIONS**

START AND STOP

Before starting the engine

1. Check "Daily Maintenance" items, see PERIODIC MAINTENANCE.
2. Turn start key to contact position and check if battery charge and engine oil pressure indicator lamps are switched on.

If the engine has been stayed inactive for a long period, bleed the fuel system.

Start

Warning: POSITION TRANSMISSION LEVER TO NEUTRAL.

1. Position key in start position for seven seconds, at the maximum.

If engine doesn't work, repeat operation after 30 (thirty) seconds.

Note: Do not keep the key turned too much long, because it will damage the starter.

In turbocharged engines, after to start, do not accelerate over than 1000 rpm, during the firsts 30 (thirty) seconds. This allows turbocharger lubrication line pressure equalization avoiding damages to this equipment.



Key Positions


1. Off
2. Contact
3. Start

2. Check the panel instruments, engine noise and exhaust gases.

In case of any irregularity, stop the engine and immediately look for our Distributors Network and / or Authorized Services.

Note: Do not extremely load the engine, while it is not at the normal operation temperature.

Stop

 **Warning:** Let the engine in idle speed and transmission lever in neutral.

In turbocharged engines, in order to do not damage the turbocharger shaft, the engine must run during 30 (thirty) seconds under 1000 rpm before stopped.

- Do not accelerate the engine.
- Turn key to “off” position.

RUNNING-IN

The technology that INTERNATIONAL ENGINES SOUTH AMERICA LTDA uses on its engines production, as well as on tests in dynamometer, eliminate the necessity of large run-in periods. Generally, it is considered the firsts 2500 km (1550 mi) of work as the necessary period for the run-in, which can vary according to each application that each product is used.

During running-in follow these recommendations:

- DO NOT OPERATE THE ENGINE AT OVER THAN 85% OF THE MAXIMUM SPECIFIED SPEED (3800 rpm), see TECHNICAL SPECIFICATIONS.
- WHEN IN A TRIP, VARY THE ROTATION TO AVOID CONSTANT SPEEDS DURING LONG PERIODS. DO NOT BRUSQUELY ACCELERATE THE ENGINE.

During useful life of the engine:

- Before starting, check lubricant oil, cooling system water and fuel levels.
- Do not warm the engine up in idle speed but varying its speed.
- To reach the normal operation temperature, move the vehicle without extremely loading and without exceeding 3800 rpm.
- Do not let the engine running in idle speed without need.
- Keep the engine operation temperature between 86 and 102 °C (187 and 216 °F) engine.

Note: It is operator responsibility the correct use of the product during the running-in. The not execution of the recommendations above mentioned will provoke the decrease of the product useful life, with consequent increase of the lubricant oil consumption to higher levels than the ones defined by the project.

REVISION PROGRAMS

The engine warranty is conditioned to the accomplishment of the delivery revisions, and more the revisions mentioned in the Warranty Certificate.

Our Distributors and / or Authorized Services Net must make all obligatory and periodic revisions operations according to the instructions of this Manual.

Optional equipment installation, not originals from factory, will cancel warranty and may cause serious damages to the engine, with consequent decrease of its useful life.

For a better engine performance, always use genuine parts.

INSTALLATION REVISION

ITEM	CHECK
Alternator belt	Tension
Water and lubricant oil	Level (complete if necessary)
General performance	Operation temperature and speed at maximum load
Intake system	Intake air temperature and restriction
Fuel system circuit	If the piping is unobstructed and free of vibrations, extreme heat areas and leakages occurrences
Exhaust system	If there isn't restriction to the exhaust gases
Command system	Accelerator course
Engine fixation	Alignment among engine and transmittion
Instrument panel	Indicators, warning lamps and sensors functioning
Cooling system	Radiator, hoses, piping and clamp conditions

PERIODIC MAINTENANCE

PERIODS								CHECK
15,000 km (9,300 mi)	30,000 km (18,600 mi)	45,000 km (27,900 mi)	60,000 km (37,300 mi)	75,000 km (46,600 mi)	90,000 km (55,900 mi)	105,000 km (65,200 mi)	120,000 km (74,600 mi)	
Daily								Check engine oil level (complete if necessary).
Daily								Check water "reservoir" level (complete if necessary).
Daily								Drain impurities from the fuel filter and sedimentation filter.
Daily								Check air filter hoses and connections conditions.
●	●	●	●	●	●	●	●	Check the terminals and battery level.
●	●	●	●	●	●	●	●	Retighten engine rubber pads.
●	●	●	●	●	●	●	●	Replace lubricant oil and filter.
●	●	●	●	●	●	●	●	Replace fuel filter element.
●	●	●	●	●	●	●	●	Adjust valves clearance.
●	●	●	●	●	●	●	●	Check idle speed*.
●	●	●	●	●	●	●	●	Check teeth belt conditions, through the inspection lateral plug.
●	●	●	●	●	●	●	●	Check external belts conditions.
●	●	●	●	●	●	●	●	Cooling system: check anti-freezing (replace at each 2 years).
●	●	●	●	●	●	●	●	Check oil - fuel - cooling piping conditions.
							●	Replace external belts.
							●	Replace toothed belt.
			●				●	Evaluate starter, alternator and turbocharger**.

After the first change at 15.000 km (9,300 mi) lubricant oil and oil filter must be obligatory changed at each 15.000 km (9,300 mi) or 6 months maximum (which one first occurs). Fuel filter must be replaced and fuel tank clean (maximum) at each 6 months, even without reached the limit of 15.000 km (9,300 mi) (recommended for the fuel filter change).

* Services that have to be made by Distributors / Authorized Services Net.

** Services that have to be made by part manufacturer.

Remark: For vehicles that work predominantly in regions where sulfur index in fuel is over than 1%, lubricant oil change intervals must be at each 7.500 km.

TURBOCHARGER

The turbocharger is compound of a rotary turbine and a air compressor, located in opposite sides of a same shaft. The compressor and turbine rotors are covered by housing denominated compressor and turbine, which function is to direct the gases flow through the rotors shovels.

These gases having energy in pressure, temperature and speed form, cause the rotation of the turbine rotor and consequently of the compressor rotor.

With the rotation, the atmospheric air (that must be properly filtrate) is aspired, and later on, compressed to the compressor rotor from where goes to turbocharging (in turbocharged International HS 2.8L engines) and later on to the engine cylinders. Having a higher pressure in the intake, the work done by the cylinders is positive, in other words, the cylinders spent a smaller amount of energy in the intake.

In turbocharged International HS 2.8L engine, the turbocharger is also composed by a Wastegate valve or VNT, which controls the maximum pressure to be provided by the compressor, to avoid damages in the engine.

Other advantage:

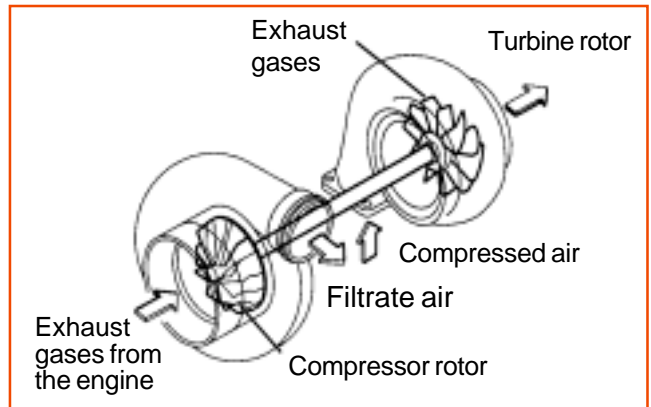
Existing a larger mass of air, we can fire a larger amount of fuel, besides we get a better combustion of the mixture.

The operation of an engine equipped with turbocharger does not require any special procedure.

Anyway, to assure the maximum durability of the turbocharger, take care of these items:

To accelerate the engine immediately after starting damages the turbocharger, because it gets a high speed without the oil flow need on its shaft.

To accelerate the engine before stop it, also damages the turbocharger, because it stops the lubrication but, on the other hand, the turbo shaft still has a high speed.



The intake of strange objects, even smalls, will damage the rotor of the compressor, damaging the operation of the turbocharger, this way, between the recommended periods check the air filtering system.

By working at high speeds and temperatures, the turbo requires a lubricant oil that accomplish to these requirements, and never should be used a lubricant oil that does not attend to API / ACEA specification (5th class - multi-viscous).

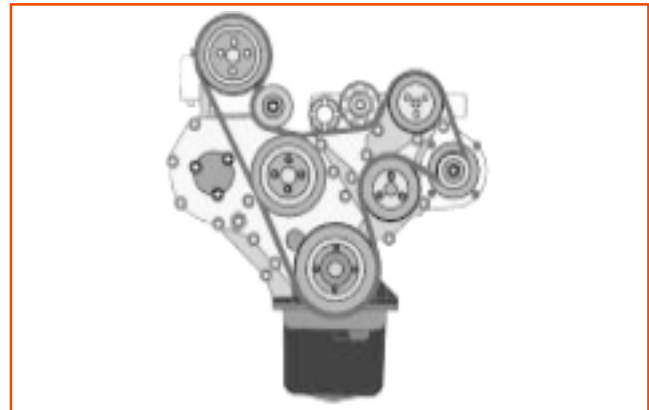
ACCESSORIES BELTS

If the panel of the equipment accuses high temperature and / or battery low charge, check if the belt is loose or ruptured.

Two belts equip the turbocharged International HS 2.8L engine. It is very important that the belts be installed exactly as shown in the illustration.

Two tensors adjust automatically the belts tension, eliminating this way the necessity of individual adjustment.

The belts must be checked at each service and replaced when necessary.



Off-road use

Belts regular checks are essential if the vehicle is used off-road. When executing service in the vehicle, the owner must be contacted to identify the way in that the vehicle's mileage has been get.

After each off-road use, the owner must check the belts for cuts and damages caused by stones. If one of the belts gets loose, it must be repositioned correctly, replacing in the next service or before, depending on the damage level.

Belts conditions check

Check belts conditions, replacing them if they present waste, cracks or contamination with oil.

CAMSHAFT BELT

The engine timing pulleys are moved by a flexible rubber belt, which must be replaced in predetermined intervals depending on the use conditions severity.



Note: If the belt is not replaced within the correct intervals, it may present failures, causing serious damages to the engine.

Follow strictly the specifications of belt tensor tightening, guaranteeing its useful life, according the recommendation.