TECHNICAL SPECIFICATION

Description:
Offshore Diving Support 102 meters

Number
03102301D-06

Date
2 November 2012

WÄRTSILÄ

TECHNICAL SPECIFICATION

WÄRTSILÄ

1 Propulsion machinery

General

Ambient conditions

The equipment is designed for the following conditions:

Maximum ambient air temperature	45	°C
Maximum LT cooling water temperature before engine	38	°C
Maximum sea water temperature	32	°C

Classification

The equipment meets the requirements of DNV for unrestricted service at the date of quotation.

Flag state

The Buyer shall confirm to Wärtsilä the flag state latest before contract signing.

Ship(s) delivery date

The Buyer shall inform to Wärtsilä the actual ship delivery date after the ship is delivered to ship owner.

Warranty

The Buyer shall confirm to Wärtsilä the date of flag shift.

Warranty co-ordinator

The Buyer shall confirm to Wärtsilä who handles warranty matters.

Validity of classification and other rules

The Equipment shall be delivered according to the valid edition of the mentioned rules, regulations and requirements of the Classification Society and Authority or Marine Organization at the date of the quotation. In the event that the rules, regulations and requirements of the Classification Society or Authority or Marine Organization change after the quotation date the Supplier shall have the right to adjust the quotation price and the Delivery date resulting from such changes.

Electric power supply

If not specially mentioned, all electrical equipment delivered with the engine is designed to operate with:

Main voltage	3x690	V
Frequency	60	Hz
Control voltage	24	VDC

Fuel oil quality

The equipment is specified for fuel according to ISO 8217:2010 (E) with a viscosity of max. 11 cSt/40°C.

MDF

The following conditions, not specified in the ISO standard also apply:

Viscosity min., before injection pumps	1.8 cSt
Viscosity max., before injection pumps	24 cSt
Sodium before engine, max	30 mg/kg

Aluminium + Silicon before engine, max.....15 mg/kg
Flash point (PMCC), min..... 60 °C
Pour point, max..... 0-6 °C

Water quality

Fresh cooling water shall be treated with approved products.

Lubricating oil quality

Only approved oils shall be used for the equipment.

1.1 Main Engine(s)

1.1.1 Wärtsilä 8L20 4

Application

Engine driving a generator at constant speed.

Main particulars

Max continuous rating (MCR)	1480	kW
Speed	900	rpm
Configuration	In-line engine	
Number of cylinders	8	
Cylinder bore	200	mm
Stroke	280	mm
Swept volume per cylinder	8.8	dm^3
Mean piston speed	8.4	m/s
Mean effective pressure	28	bar
Direction of rotation, looking at driving end	Clockwise	

The max continuous rating (MCR) is valid at ambient conditions mentioned above.

Fuel oil consumption (SFOC)

Fuel consumption at shaft according to ISO 3046/1 without engine driven pumps using MDF and corrected to a net calorific value of 42,700 kJ/kg:

85 % load	189	g/kWh
Tolerance	± 5	%

Lubricating oil consumption

85 % load	max 0.5	g/kWh

Lubricating oil consumption does not include treatment losses or oil changes.

NOx Emissions

The standard engine complies with the maximum permissible NOx emission according to the MARPOL 73/78 ANNEX VI Tier II NOx emission standard.

Testing

The engine will be tested at the max continuous rating (MCR) in our workshop in accordance with the requirements of the classification society and our own standard specification. The fuel oil used during the test run is MDF. After test run the fuel rack position will be limited to 110% MCR.

Engine specification

The engine is a four-stroke, turbocharged and intercooled diesel engine. The following equipment is mounted on the engine:

Fuel system

- One injection pump per cylinder
- Direct driven fuel feed pump with built-in safety valve, With stand-by connection
- Fuel fine filter of duplex type equipped with a differential pressure alarm switch. The filter inserts can be exchanged with engine running.
- Spring loaded control valve in the return pipe

Lubricating oil system

- Direct driven lubricating oil pump with built-in safety valve and pressure regulating valve, Without stand-by connections
- Electric motor driven pre-lubricating oil pump with built-in safety valve
- Automatic lubricating oil filter of back flushing type equipped with a differential pressure sensor
- Centrifugal filter mounted in the back flushing line
- Lubricating oil cooler of plate type
- Lubricating oil thermostatic valve
- Wet oil sump
- Separator connections including shut off valves

Starting air system

- Starting air motor with pressure reducing and safety valve
- Starting air master valve
- Blocking valve for turning gear
- Control air container
- Non-return valve

Cooling water system

- Engine driven HT-cooling water pump Without stand-by connection
- HT thermostatic valve, direct acting type
- Adjustable orifice in HT by-pass line
- Engine driven LT-cooling water pump Without stand-by connection
- LT thermostatic valve, direct acting type
- Adjustable orifice in LT by-pass line

Combustion air and exhaust gas system

- Turbocharger(s) with air filter and silencer at Free end of engine
- Exhaust gas outlet(s) orientation, 0° from vertical
- Single-stage charge air cooler(s)
- Connection(s) for cleaning device of turbine
- Cleaning device for compressor(s), manually operated
- Air waste gate
- Variable inlet valve closing system

Control and monitoring equipment on engine

- Fuel rack actuator for electronic speed control.
- Two speed pickups for electronic speed control
- Electro-pneumatic shutdown system independent of the governor
- Microprocessor based distributed real time system for engine control and monitoring
  Main components:
  - Engine safety module for shutdown of engine acc. to class requirements

- Main control module for internal engine control functions
- Input /output modules for handling of sensor data

Main functions:

- shutdowns (e.g. lubricating oil pressure, overspeed)
- start blockings (e.g. lubricating oil pressure, turning gear)
- measuring of engine and turbocharger speed
- normal start and stop of the engine
- engine speed control
- other internal engine control functions as applicable
- signal processing of engine monitoring and alarm sensors
- data communication with ships alarm & monitoring system through Ethernet Modbus TCP or RS-485 serial link Modbus RTU
- hardwired interface with external systems for control functions such as remote start and stop

Operator interface

The operators interface is based on a local control panel (LCP) built on the engine, consisting of a display unit, backup indications and control switches & buttons.

The local display unit shows all engine measurements (e.g. temperatures and pressures) and provides various engine status indications as well as an event history

The following independent backup indications are available:

- Engine rpm
- Turbocharger rpm
- Running hours
- HT water temperature
- Lubricating oil pressure

The LCP is equipped with the following control switches and pushbuttons:

- BLOW/BLOCKED/LOCAL/REMOTE control mode switch
- Local START/STOP pushbuttons
- Trip/Shutdown RESET pushbutton
- Emergency stop pushbutton

Sensors

- Alarm, safety and measuring sensors according to maker and class requirements.
- Connections for testing of pressure sensors
- Sensors are wired to the engine mounted I/O- and control modules

Miscellaneous

- Flywheel with a gear rim for turning
- Manual turning device
- Crankcase explosion valves
- Indicator valve in each cylinder head
- Nameplates in English
- Counter flanges, gaskets, bolts and nuts
- Torsional vibration damper or tuning mass in case needed

Painting

- The generating set will be painted with factory standard colour RAL 5019 Capri Blue

1.1.2 Wärtsilä 6L20 2

Application

Engine driving a generator at constant speed.

Main particulars

Max continuous rating (MCR)	1110	kW
Speed	900	rpm
Configuration	In-line engine	
Number of cylinders	6	
Cylinder bore	200	mm
Stroke	280	mm
Swept volume per cylinder	8.8	dm^3
Mean piston speed	8.4	m/s
Mean effective pressure	28	bar
Direction of rotation, looking at driving end	Clockwise	

The max continuous rating (MCR) is valid at ambient conditions mentioned above.

Fuel oil consumption (SFOC)

Fuel consumption at shaft according to ISO 3046/1 without engine driven pumps using MDF and corrected to a net calorific value of 42,700 kJ/kg:

85 % load	187	g/kWh
Tolerance	± 5	%

Lubricating oil consumption

85 % load	max 0.5	g/kWh

Lubricating oil consumption does not include treatment losses or oil changes.

NOx Emissions

The standard engine complies with the maximum permissible NOx emission according to the MARPOL 73/78 ANNEX VI Tier II NOx emission standard.

Testing

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- Spring loaded control valve in the return pipe

Lubricating oil system

- Direct driven lubricating oil pump with built-in safety valve and pressure regulating valve, Without stand-by connections
- Electric motor driven pre-lubricating oil pump with built-in safety valve
- Automatic lubricating oil filter of back flushing type equipped with a differential pressure sensor
- Centrifugal filter mounted in the back flushing line
- Lubricating oil cooler of plate type
- Lubricating oil thermostatic valve
- Wet oil sump
- Separator connections including shut off valves

Starting air system

- Starting air motor with pressure reducing and safety valve
- Starting air master valve
- Blocking valve for turning gear
- Control air container
- Non-return valve

Cooling water system

- Engine driven HT-cooling water pump Without stand-by connection
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- Adjustable orifice in LT by-pass line

Combustion air and exhaust gas system

- Turbocharger(s) with air filter and silencer at Free end of engine
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- Connection(s) for cleaning device of turbine
- Cleaning device for compressor(s), manually operated
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  - start blockings (e.g. lubricating oil pressure, turning gear)
  - measuring of engine and turbocharger speed
  - normal start and stop of the engine

- engine speed control
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- Emergency stop pushbutton

Sensors

- Alarm, safety and measuring sensors according to maker and class requirements.
- Connections for testing of pressure sensors
- Sensors are wired to the engine mounted I/O- and control modules

Miscellaneous

- Flywheel with a gear rim for turning
- Manual turning device
- Crankcase explosion valves
- Indicator valve in each cylinder head
- Nameplates in English
- Counter flanges, gaskets, bolts and nuts
- Torsional vibration damper or tuning mass in case needed

Painting

- The generating set will be painted with factory standard colour RAL 5019 Capri Blue

1.2 Fuel oil system

1.2.1 Suction strainer (MDF) 6

Duplex filter with differential pressure indicator with alarm contact. The inserts can be exchanged with engine running.

1.2.2 Cooler (MDF) **6**

Fuel oil cooler of tube type.

- Counter flanges, gaskets, bolts and nuts

1.3 Compressed air systems

1.3.1 Starting air vessel **2**

The total air volume of the starting air vessels are calculated for 18 starts.

Starting air vessel (0.500 m^3) for Vertical mounting with:

- Valve head assembly with inlet, outlet, drain and safety valves
- Counter flanges, gaskets, bolts and nuts

Starting air vessel size to be confirmed by customer, since the approval discussions are carried out between system designer and classification society.

1.3.2 Air filter (starting air inlet) for 4 x Wärtsilä 8L20 ..... **4**

- engine built air equipment protection strainer

1.3.3 Air filter (starting air inlet) for 2 x Wärtsilä 6L20 ..... **2**

- engine built air equipment protection strainer

1.4 Cooling water systems

1.4.1 Preheating unit **2**

HT cooling water preheating unit with:

- Electric heater
- Circulating pump
- Control cabinet for heater and pump
- The unit is dimensioned to warm up the engine(s) from 20°C to 60°C in 10-15 hours, excluding losses in the external system.
- The unit is dimensioned for 3 engine(s).

1.5 Combustion air and exhaust gas systems 1

1.5.1 Turbocharger cleaning device **1**

Turbocharger water cleaning device for turbocharger turbine side:

- Dosing unit
- 10 meter hose with quick couplings

1.5.2 Exhaust gas bellows **4**

Flexible expansion bellows after turbocharger.

- Counter flanges, gaskets, bolts and nuts

1.5.3 Exhaust gas silencer with spark arrestor **4**

Uninsulated exhaust gas silencer with spark arrestor with approximately 35 dB(A) noise reduction.

- Counter flanges, gaskets, bolts and nuts

1.6 Combustion air and exhaust gas systems 2

1.6.1 Turbocharger cleaning device 1

Turbocharger water cleaning device for turbocharger turbine side:

- Dosing unit
- 10 meter hose with quick couplings

1.6.2 Exhaust gas bellows 2

Flexible expansion bellows after turbocharger.

- Counter flanges, gaskets, bolts and nuts

1.6.3 Exhaust gas silencer with spark arrestor 2

Uninsulated exhaust gas silencer with spark arrestor with approximately 35 dB(A) noise reduction.

- Counter flanges, gaskets, bolts and nuts

1.7 Control and monitoring systems

1.7.1 Power Unit for 4 x Wärtsilä 8L20 4

Power unit for supply of isolated and duplicated 24VDC to the engine.
Cabinet for bulkhead mounting, protection degree: IP44

Main components

- 230VAC/24VDC power supply converter
- 24VDC/24VDC power supply converter
- Miniature Circuit Breakers (MCBs) and terminals

The converters are dimensioned for 100% load and redundant. Failure of one supply will cause automatic takeover by the second supply.

Required power supply from ship's system:

- Supply 1: 230VAC / abt. 150W
- Supply 2: 24VDC/ abt. 150W.

At least one of these must be connected to UPS or battery backup on ship's side.

1.7.2 Power Unit for 2 x Wärtsilä 6L20 2

Power unit for supply of isolated and duplicated 24VDC to the engine.
Cabinet for bulkhead mounting, protection degree: IP44

Main components

- 230VAC/24VDC power supply converter
- 24VDC/24VDC power supply converter
- Miniature Circuit Breakers (MCBs) and terminals

The converters are dimensioned for 100% load and redundant. Failure of one supply will cause automatic takeover by the second supply.

Required power supply from ship's system:

- Supply 1: 230VAC / abt. 150W
- Supply 2: 24VDC/ abt. 150W.

At least one of these must be connected to UPS or battery backup on ship's side.

1.8 Foundation

1.8.1 Flexible pipe connections spare set 1

Spare set of flexible hoses including one for each type of pipe connections on engine(s).

1.8.2 Flexible pipe connections for 4 x Wärtsilä 8L20 4

Flexible hoses for the pipe connections on engine(s).

1.8.3 Common base frame for 4 x Wärtsilä 8L20 4

Foundation for the engine and the alternator:

- Common base frame of welded steel
- Flexible mounts for common base frame
- The generator and engine will be mounted on the common base frame at our factory
- Alternator fittings materials are included.
- Flywheel cover between engine and alternator

1.8.4 Flexible pipe connections for 2 x Wärtsilä 6L20 2

Flexible hoses for the pipe connections on engine(s).

1.8.5 Common base frame for 2 x Wärtsilä 6L20 2

Foundation for the engine and the alternator:

- Common base frame of welded steel
- Flexible mounts for common base frame
- The generator and engine will be mounted on the common base frame at our factory
- Alternator fittings materials are included.
- Flywheel cover between engine and alternator

1.9 Power transmission

1.9.1 Flexible coupling (flywheel) for 4 x Wärtsilä 8L20 4

The final choice of flexible coupling will be based on the torsional vibration calculations (made after the order).
Bolts for connecting the coupling to the flywheel

1.9.2 Flexible coupling (flywheel) for 2 x Wärtsilä 6L20 2

The final choice of flexible coupling will be based on the torsional vibration calculations (made after the order).
Bolts for connecting the coupling to the flywheel

1.9.3 Generator 8L20 4

Brushless 3-phase synchronous alternator for marine installation with separate or built-in automatic voltage regulator.

Output	2360	kVA
Speed	900	rpm
Frequency	60	Hz
Voltage	660	V
Cos.phi	0.6	
Insulation / Temperature rise	H/F	
Bearings	Sleeve	
Enclosure	IP 44	
Mounting	IM1101	

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Construction

The frame and the end shields are of welded or cast construction, treated with primer for protection against corrosion. The outer surfaces are treated at the factory with paint finish. The rotors are designed to withstand the vibration caused by the prime mover and the stresses appearing at 120% rated speed.

Water cooling

The generator is cooled with a shaft mounted fan. The cooling air is circulated inside the generator through a double tube air-to-water heat exchanger.

Sleeve bearings

Sleeve bearings are of split type. They are spherically seated to facilitate easy assembly and maintenance.

Brushless excitation

The excitation system comprises an electronic voltage regulator, an exciter and a rotating diode bridge. The voltage regulator controls the generator output voltage, supplying the excitation current to the exciter. The exciter and the diode bridge operate as an amplifier and supply the excitation current to the generator main poles.

Voltage control

The generator can be operated in parallel. A current transformer for reactive load compensation is used. The degree of compensation can be adjusted to meet the requirements for parallel operation with other generators. The static accuracy of the generator voltage is better then ±1% at all symmetrical loads from no-load to rated load. The voltage can be set steplessly within ±10% of the rated voltage.

Overcurrent capability

The stator winding withstands a current, which can be over 3 times the rated current for about 10 seconds.

Accessories

- Anti-condensation heater 230 VAC
- 6 pieces of PT 100 in stator windings, (3 in use and 3 as spare)
- One PT 100 in each bearing

Preliminary reactances and time constants

One set of spare parts according to the recommendation of the classification society is included.

1.9.4 Generator 6L20.....2

Brushless 3-phase synchronous alternator for marine installation with separate or built-in automatic voltage regulator.

Output	1765	kVA
Speed	900	rpm
Frequency	60	Hz
Voltage	660	V
Cos.phi	0,6	
Insulation / Temperature rise	H/F	
Bearings	Sleeve	
Enclosure	IP44	
Mounting	IM1101	

WÄRTSILÄ

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The frame and the end shields are of welded or cast construction, treated with primer for protection against corrosion. The outer surfaces are treated at the factory with paint finish. The rotors are designed to withstand the vibration caused by the prime mover and the stresses appearing at 120% rated speed.

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- 6 pieces of PT 100 in stator windings, (3 in use and 3 as spare)
- One PT 100 in each bearing

One set of spare parts according to the recommendation of the classification society is included.

1.10 Tools and spare parts

1.10.1 Tools (engine) 1

Tools for the engine according to enclosed tools list T03102301D-03.

1.10.2 Spare parts (engine) 1

Spare parts according to the recommendations of the IACS, unrestricted service, for the engine(s) according to enclosed spare parts list S03102301D-03.

1.11 Packing and transportation

1.11.1 VCI-coating for 4 x Wärtsilä 8L20 4

The engine is protected during transportation by a plastic VCI-film (Volatile Corrosion Inhibitor).

1.12 Technical documentation

Installation Planning Instructions

Delivery includes, in English, Installation Planning Instructions (IPI) necessary for Buyer's installation work of equipment in Wärtsilä scope of supply.

Any delivery schedule of the IPI is subject to timely supply of necessary, complete and correct technical data and drawings by Buyer.

InfoBoard

InfoBoard enables online access to project specific documentation (IPIs) and product related documentation (Project Guides). InfoBoard can be accessed via any internet service provider with one or several personal login names and passwords free of charge.

Operating & maintenance manuals, spare parts catalogues, certificates and the record book of engine parameters are also published through InfoBoard.

Type	Media	Language	Qty
Installation planning instructions (Wärtsilä 8L20)	InfoBoard + A4 binder	English	3
Installation planning instructions (Wärtsilä 6L20)	InfoBoard + A4 binder	English	3

Classification drawings

Buyer shall prepare and submit to the relevant Classification Society and Authorities (class) all drawings necessary for certification and approval of the vessel unless otherwise specifically stated. Wärtsilä shall provide equipment certificates of equipment within the scope of supply.

Torsional Vibration Calculation

Torsional Vibration Calculations (TVC) of systems mechanically driven by Wärtsilä engine(s) will be made and submitted for class approval by Wärtsilä.

Data and drawings of equipment NOT included in Wärtsilä scope of supply, which are required for preparation of TVC, shall be supplied to Wärtsilä not later than four (4) weeks after Contract, unless otherwise agreed.

Set of engine Operating & Maintenance manuals (O & M manuals) and spare parts catalogues per ship set for the equipment included in Wärtsilä scope of supply.

Operating & Maintenance manuals

Operating & Maintenance manuals cover instructions and descriptions by text and pictures of the main actions and cautions needed when operating the delivered equipment. The engine Operating & Maintenance manual are made specific for the delivered engine(s).

Spare Parts Catalogues

Spare Parts Catalogues contain the needed pictures for identification of spare parts to be ordered, stored or installed. The Spare Parts Catalogue furthermore contains Wärtsilä specific Spare Part Numbers, which shall be used when ordering parts. The Spare Parts Numbers are connected to Wärtsilä's unique Code Resolution system, enhancing the precision of spare parts processing and minimizing the need for updating at the customer's side.

Type	Media	Language	Qty
O & M manual (Wärtsilä 8L20)	A4 binder	English	3
Spare parts catalogue (Wärtsilä 8L20)	A4 binder	English	3
O & M manual (Wärtsilä 6L20)	A4 binder	English	3
Spare parts catalogue (Wärtsilä 6L20)	A4 binder	English	3

Record Book of Engine Parameters

The Record Book of engine Parameters lists all the parts being under the emission regulations with pictures and codes and also contains original certificates.

Delivery 1 pcs Book of Engine Parameters as A4 binder.

1.12.2 ELDOC 1

ELDOC2i, electronic documentation on CD (1 pcs)

ELDOC2i software provides an Interactive Electronic Technical Manual (IETM) designed to give rapid access to extensive technical documentation through an interactive and easy-to-use interface. ELDOC2i contains in English an engine specific instruction manual, engine specific spare part catalogue with technical illustrations, drawings and step-by-step instructions supported by digital video and photo sequences (digital media availability depending on engine type).

1.12.3 Inventory of Hazardous Materials (IHM) 1

The Inventory of Hazardous Materials documentation is made in accordance with the IMO International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009.

1.13 Commissioning

Commissioning support or sea trial participation exceeding the contracted

If required commissioning support, due to reasons attributable to Buyer, exceeds the contractual amount based on a normal working week of sixty (60) hours and a normal working week of six (6) days, not exceeding ten (10) hours per day, Wärtsilä has the right to charge Buyer for overtime, man days and travel expenses exceeding the contractual amount according to the valid Wärtsilä Service Charges Price List.

Conditions related to commissioning

A commissioning kick-off meeting shall be held prior to starting commissioning activities to agree on a commissioning plan for the Wärtsilä scope of supply.

Wärtsilä personnel shall only be employed for consulting purposes and technical advice in connection with commissioning work.

Technical documentation in form of drawings, specification etc. which might be necessary for the successful completion of commissioning work shall be supplied by Buyer.

Time required for checking the installation prior to start of engine(s) shall be reserved by Buyer. During this installation check, no other major jobs are allowed in the engine room. No welding or spray painting may be done above or next to the engine(s), unless agreed in writing with Wärtsilä representative.
Wärtsilä personnel shall not assume responsibility for the engine room and other equipment in connection with sea trials. For this purpose a qualified chief engineer responsible for the vessel shall be present at the expense and initiative of the Buyer.

1.13.1 Pre-commissioning and commissioning support 1

Support for pre-commissioning and commissioning of the installation including travelling and lodging costs. Commissioning support included for maximum:

- 70 man-days at yard during 3 visit(s)

Buyer shall notify Wärtsilä at least two (2) weeks before mobilization of personnel is required.

1.13.2 50h Service 1

1.13.3 Commissioning spares 1

Commission spare parts

Part number	Description	Quantity
100023	O-ring	2
107017	Sealing set for covers	1
120015	Sealing set for cylinder head overhaul	2
125002	Sealing ring selection	1
165012	O-ring	8
165015	Retainer ring	4
165052	Sealing set for injection pump	8
167020	Nozzle	8
167044	Sealing set for injection valve	8
200008	Sealing ring	1
200018	Gasket	1
200025	Gasket	1
200026	Rivet	1
218110	Overhaulkit	1
387012	Glue compound	1
471051	Sealing set for lubricating oil module	1
471063	Filter cartridge	5
471126	Sealing set	4
473153	Sealing set	1
476005	Gasket set	1

501111	Engine safety module (Only UNIC)	1
501160	Power distribution module (Only UNIC)	1
861154	Seal set for hydr. tightening tools	1
929020	Sealing ring set	1
GS792	Limit switch	1
LS204	Level switch,alarm,lubricating oil level low	1
PT101	Pressure transducer, fuel oil	1
PT401	Pressure transducer, HT-water	1
ST173	Inductive transducer	1
ST196P	Magnetic speed pick-up (Only UNIC)	1
TE402	Temp. sensor, HT-water temperature, after e.	1
TE517	Temp. sensor, exhaust gas temp., after TC	1