Diagnostic of Vehciles M14

Temperature Sensor

Measurement of ambient temperature

Coolant temperature measurement

Measurement of the intake air temperatureEngine oil temperature measurement Fuel temperature measurement

https://archiwum.allegro.pl/oferta/czujnik-temperatury-powietrza-dolotowego-bosch-i7600383232.html

Cold air (*more dense*) = More fuel for proper AF ratio.

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Engine Sensors

Engine Temperature Sensor

https://northernprecisionproducts.com/what-we-offer/housing-expertise/low-temperature-sensors/

https://www.lsenginediy.com/sensors-inputs-guide/

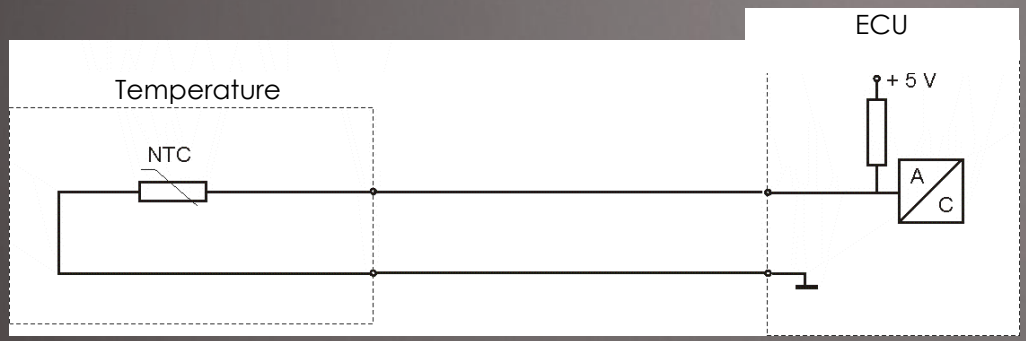
A coolant sensor is similar to a thermistor, based on the working principle that a change in electrical resistance will be the direct product of a change in the temperature of a wire carrying current. Figure 1 illustrates the main circuitry of the coolant temperature sensor. With a coolant temperature sensor, the full sensor is located in a coolant passage that sits before a thermostat and is connected to the engine control and monitoring unit.

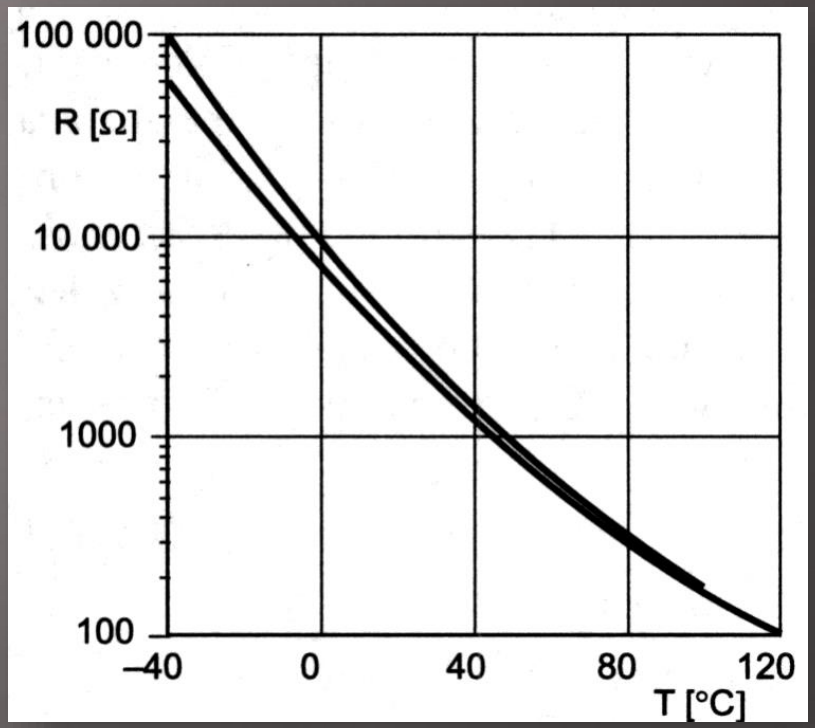
Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Temperature Sensor

Construction of a temperature sensor

Resistance sensors with resistance that change with temperature are used to measure the temperature. NTC or PTC thermistors are used and are made as wire coils, ceramic sinters, thin and thick film or single crystals. The NTC resistor is a semiconductor element whose resistance decreases with increasing temperature, whereas the PTC resistor - resistance increases with increasing temperature. In practice, NTC thermistors have found greater use because of the more linear relationship between resistance and temperature.

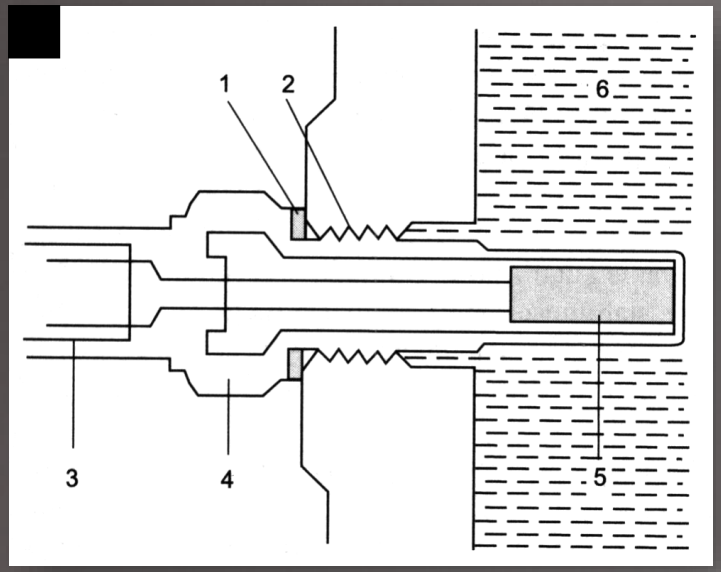




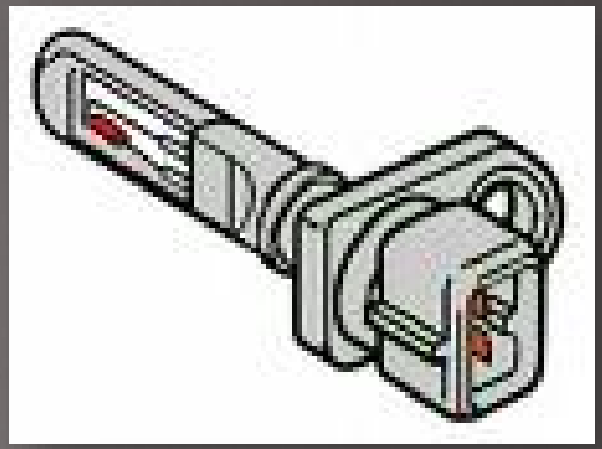
Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Temperature Sensor

Construction of a temperature sensor



1 - gasket,
2 - threaded part,
3 - electrical connector,
4 - body,
5 - measuring resistor,
6 - coolant



Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Temperature Sensor

Diagnostics of a temperature sensor

The temperature was too low (-40 ° C):

Interruption in the sensor circuit or short to positive power supply.

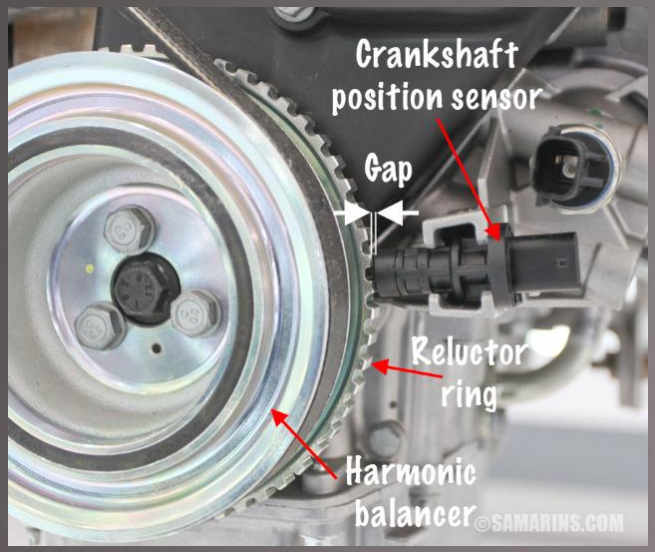
The temperature too high (+130 ° C):

Short circuit between sensor leads or output signal short to ground.

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Engine Sensors

Crankshaft Position Sensor



https://www.samarins.com/glossary/crank_sensor.html

https://shop.advanceautoparts.com/r/car-projects/how-to-replace-the-crank-and-camshaft-position-sensors

Detects engine speed.

Changes injector timing and duration.

The Crankshaft Position Sensor is attached to the engine block facing the timing rotor on the engine crankshaft. The sensor detects signals used by the engine ECU to calculate the crankshaft position, and the engine rotational speed.

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

RPM Sensor

The engine speed sensor informs the control unit of the engine speed and crankshaft position (GMP identification).

In addition, it is used by the OBD system to detect ignition loss in the ZI engine.

The ZS engine is also used to measure the unevenness of the engine speed at idle and correction of the fuel dose.

If there is no speed signal, the engine cannot be started.

If sensor damage occurs while the engine is running, it will stop immediately.

On some engines, the control unit may use the camshaft position (ZI) sensor signal or the injection pump shaft (ZS) position signal as a substitute signal.

Two types of sensors are most commonly used:

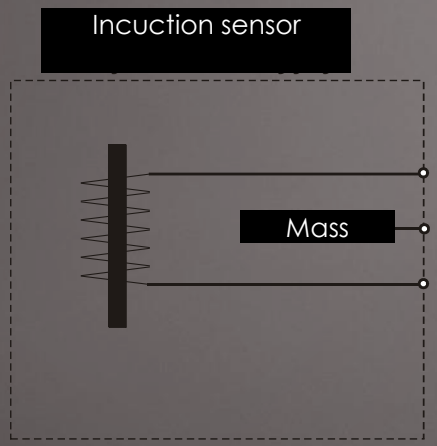
- inductive sensors
- hallotron sensors

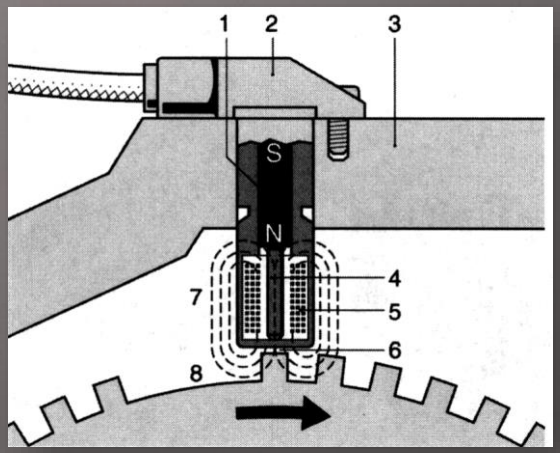
Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

RPM Sensor

Construction of an induction sensor

Induction sensors consist of a rod magnet with a magnetically soft magnet core and an induction coil with two connections. All components are located in a plastic housing. Under the influence of changes in the magnetic flux, a voltage is generated in the coil that changes proportionally to the rate of change of this flux. The value of the magnetic flux surrounding the coil depends on whether the sensor is facing the tooth or the interdental notch (the tooth strengthens the magnetic flux, the notch weakens). These flux changes induce an output voltage in the coil. It is a function of the impulse wheel rotation angle, because the magnetic flux depends on the angular position of the tooth in relation to the magnet. The thickness of the magnet core decreases towards the gear wheel to improve the sensitivity of the sensor.





1 - permanent (rod) magnet,
2 - body,
3 - engine block,
4 - magnet core,
5 - coil,
6 - air gap
(0.8 - 1.5 mm),
7 - magnetic field,
8 - ferromagnetic
impulse wheel

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

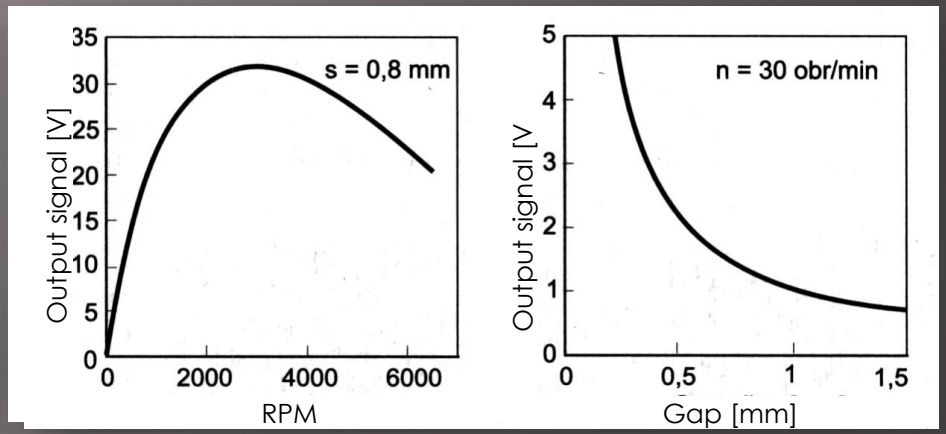
RPM Sensor

Construction of an induction sensor

Advantages of the sensor:
- immunity to electromagnetic interference,
- does not require power supply and amplification systems,
- cheap workmanship.

Disadvantages of the sensor:
- unsuitability for measuring low speeds,
- sensitivity to changes in air gap thickness,
- signal amplitude depends on the engine speed (several mV - 100 mV
- limited size reduction (coil dimensions).

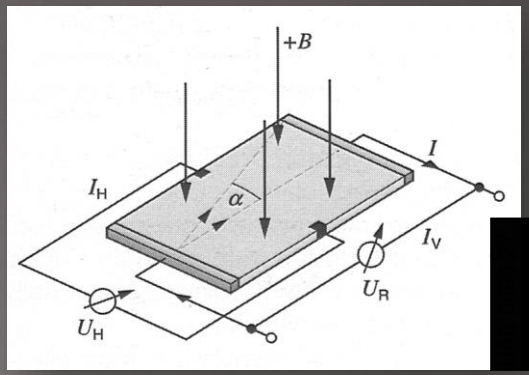
1 - engine speed n = 800 rpm,
2 - engine speed n = 3000 rpm,



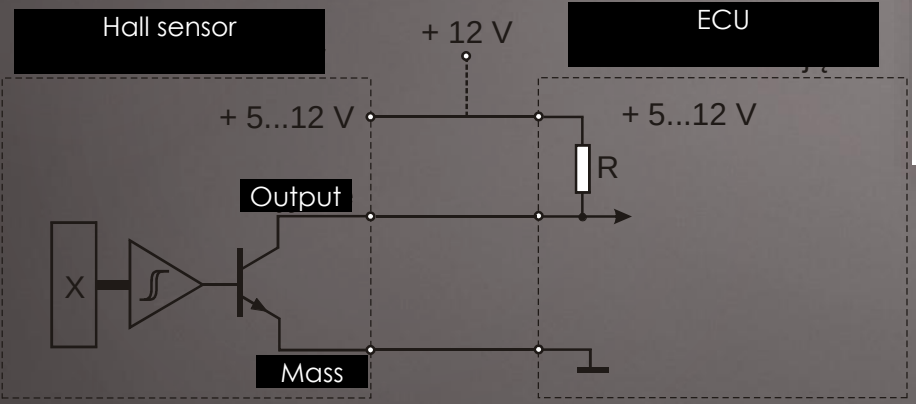
Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

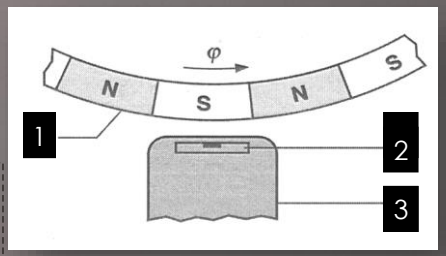
RPM Sensor

Hall sensor construction

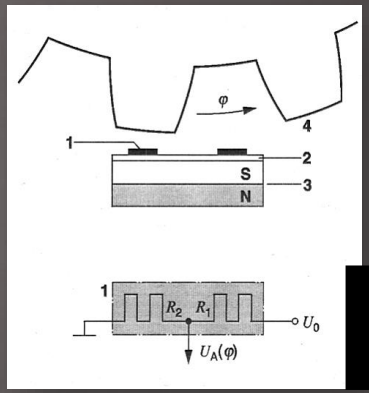


Hall effect sensors for rotational speed measurement are used as simple hall sensors with a magnetically active rotor, or as differential (halotron) sensors (gradient). The differential sensors have permanent magnets with a thin magnetic plate facing the gear. Two halotron elements are placed on the plate, half the tooth pitch, so when one element is opposite the interdental notch, the other is placed opposite the tooth. The sensor measures the difference in field strength for adjacent points in the circuit. The output signal corresponds to changes in field strength as a function of the crankshaft rotation angle. The current paths of both Hall sensors are connected in parallel, and their output voltages are connected in series to directly capture their differential voltages.





1 - magnetic rotor,
2 - hallotron sensor,
3 - sensor housing,



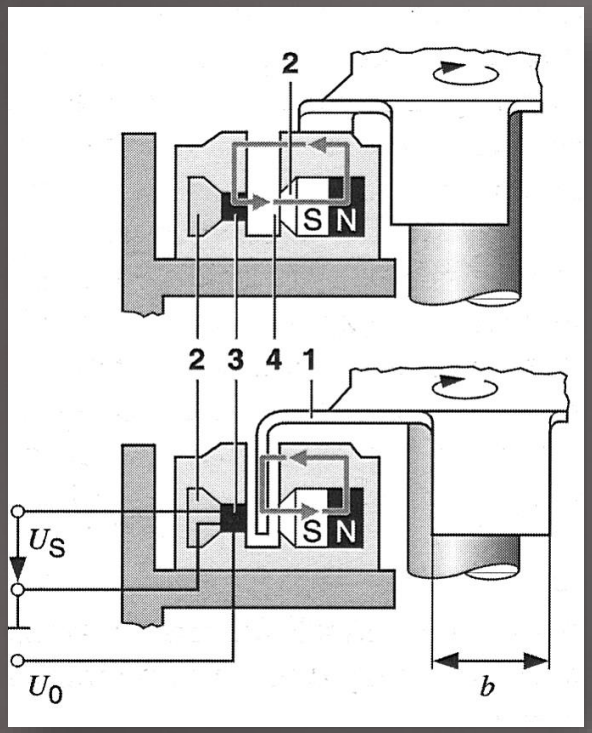
1 - Hall transducer, 2 - board magnetic, 3 - permanent magnet, 4 - gear wheel,
U0 - supply voltage,
UA - measuring voltage

Bosch: Czujniki w pojazdach samochodowych

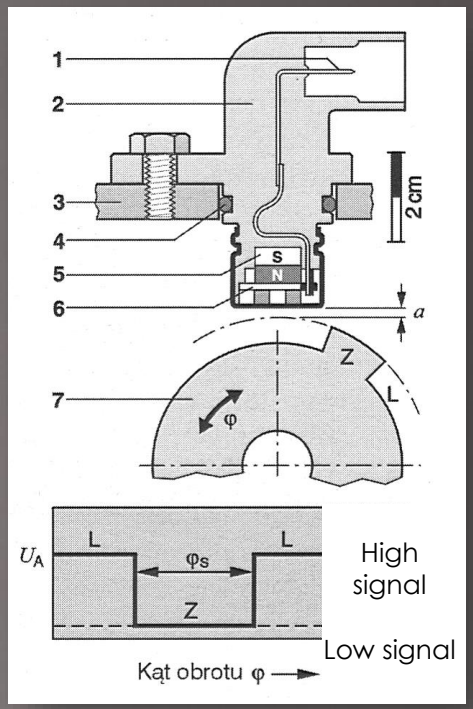
Publikacja środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Crankshaft Sensor

Hall sensor construction



1 - barrier width b,
2 - magnetically soft guides,
3 - Hall transducer,
4 - air gap,
UO - supply voltage,
US - sensor voltage,

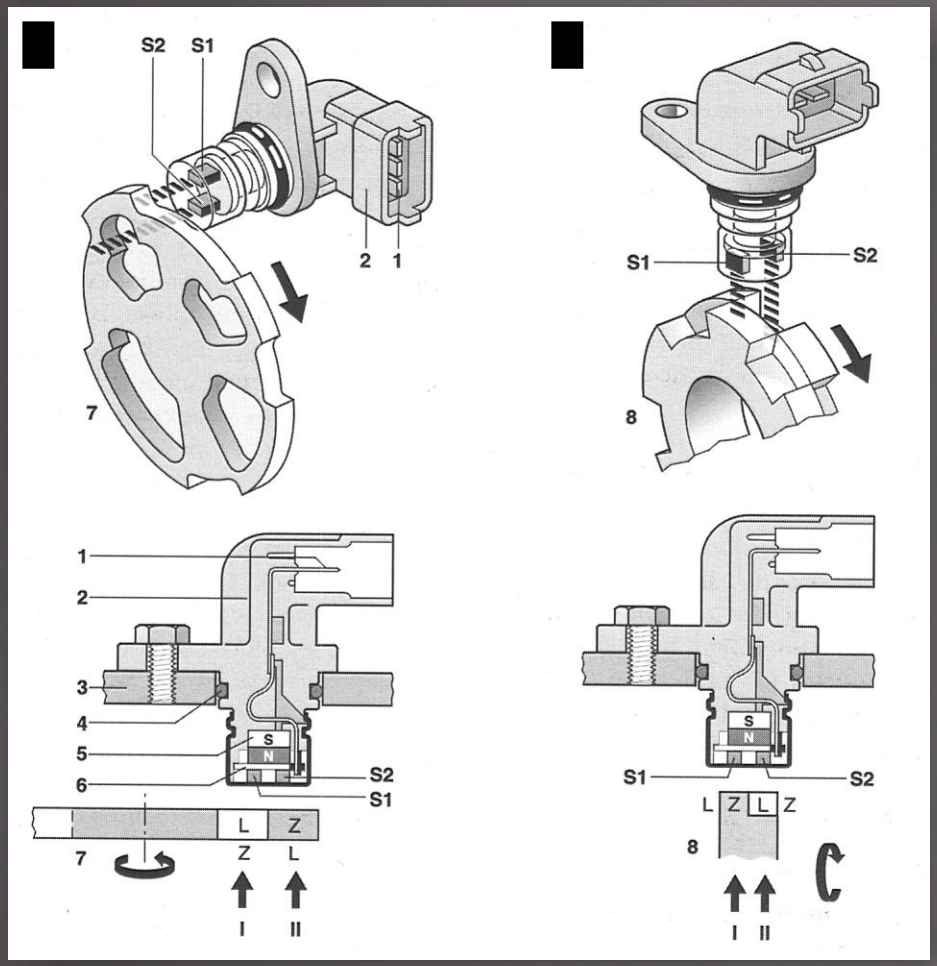


1 - electrical connector,
2 - sensor housing,
3 - engine head,
4 - sealing ring,
5 - permanent magnet,
6 - Hall transducer,
7 - impulse wheel,
a - air gap

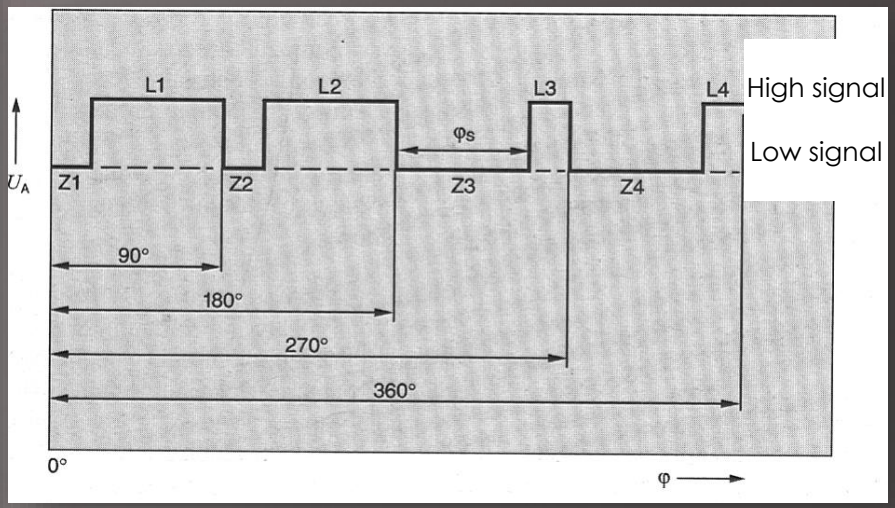
Bosch: Czujniki w pojazdach samochodowych

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Crankshaft Sensor



Hall sensor construction



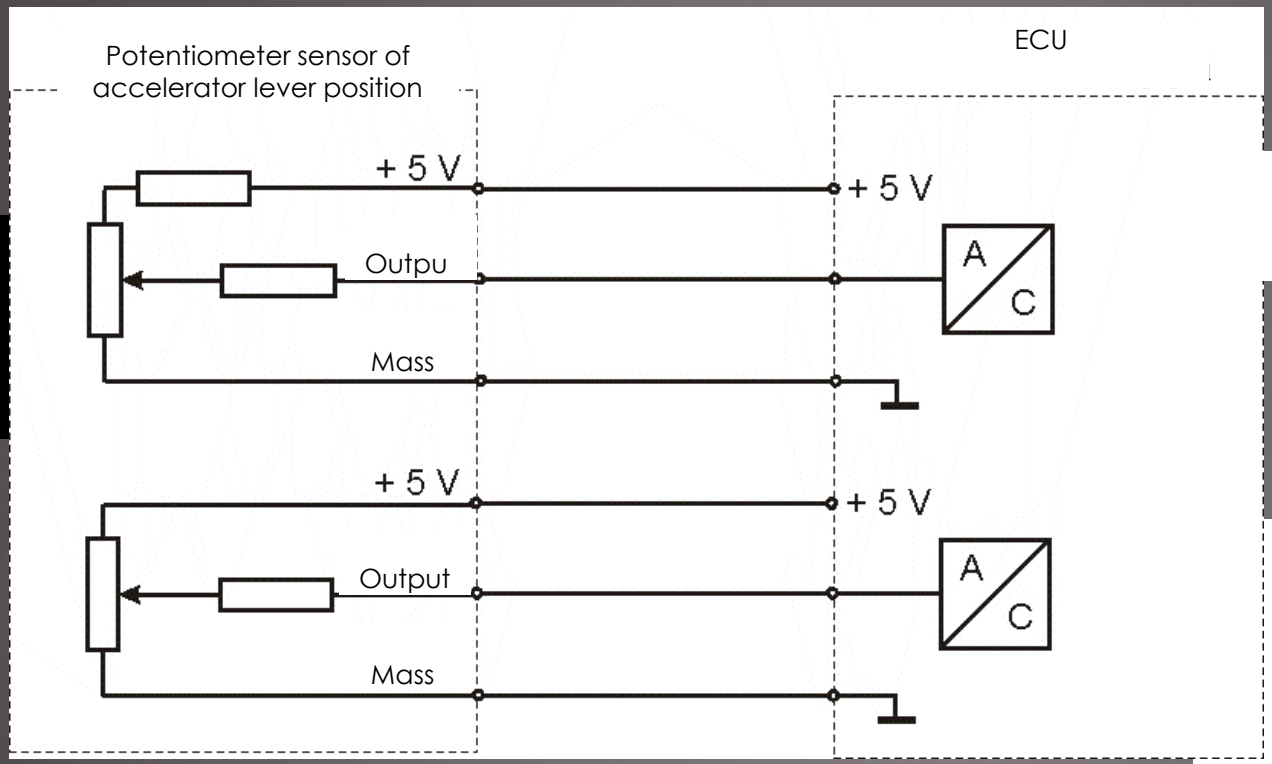
1 - electrical connector, 2 - sensor housing,
3 - engine head, 4 - sealing ring,
5 - permanent magnet, 6 - differential, hallotron
integrated transducer with Hall components S1 and S2,
7 - impulse wheel, 8 - doubled impulse wheel

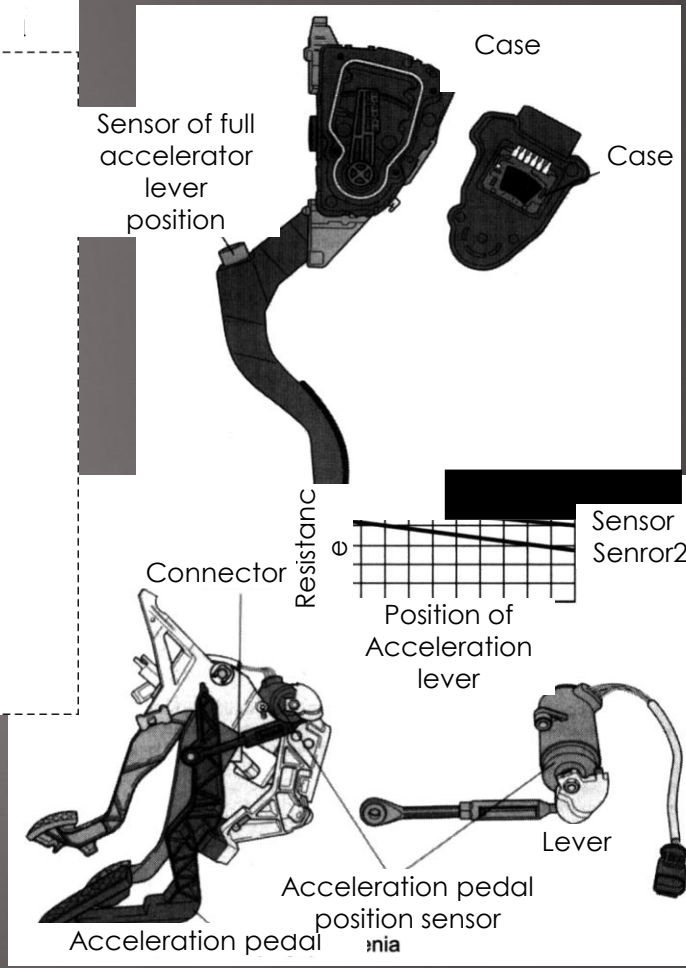
Bosch: Czujniki w pojazdach samochodowych

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Accelerator lever position sensor

Construction of a potentiometer sensor





Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Sensors - switches

Oil pressure sensor

Brake pedal position sensor

Clutch brake pedal position sensor

Power steering pressure sensor

Throttle position sensor (idle contactor)

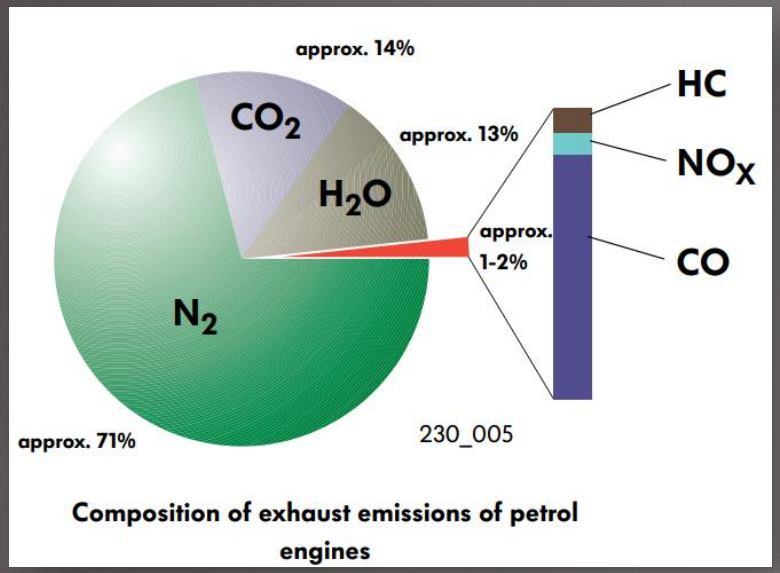
https://www.amazon.com/ACDelco-25912943-Original-Equipment-Position/dp/B0049HMQMA

https://www.aliexpress.com/i/32970070421.html

https://traktor.com.pl/en/strona-glowna/7090-clutch-pedal-position-sensor-safety-switch-l2808-l3408-dc60-dc68-.html

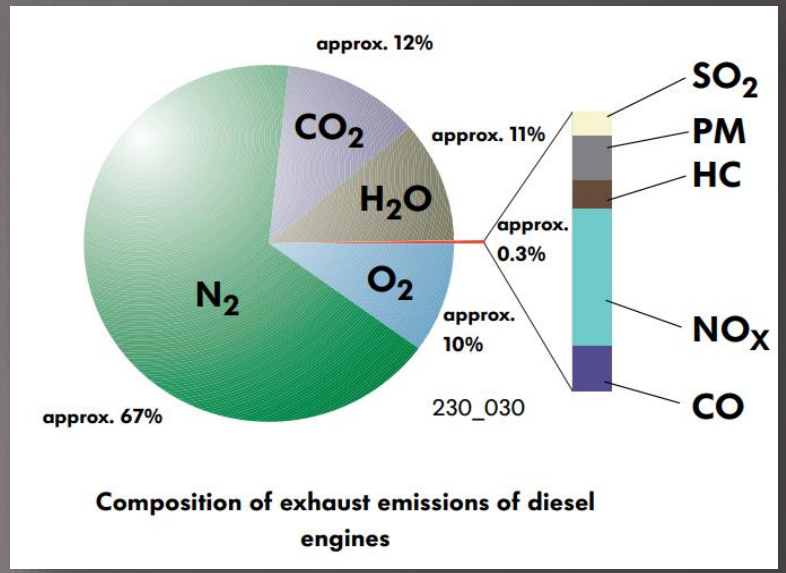
Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Composition of Exhaust Petrol -Diesel



Composition of exhaust emissions of petrol engines

https://jaumesatorra.wordpress.com/2010/01/27/tipos-de-gases-producidos-en-la-combustion-y-sus-consecuencias/



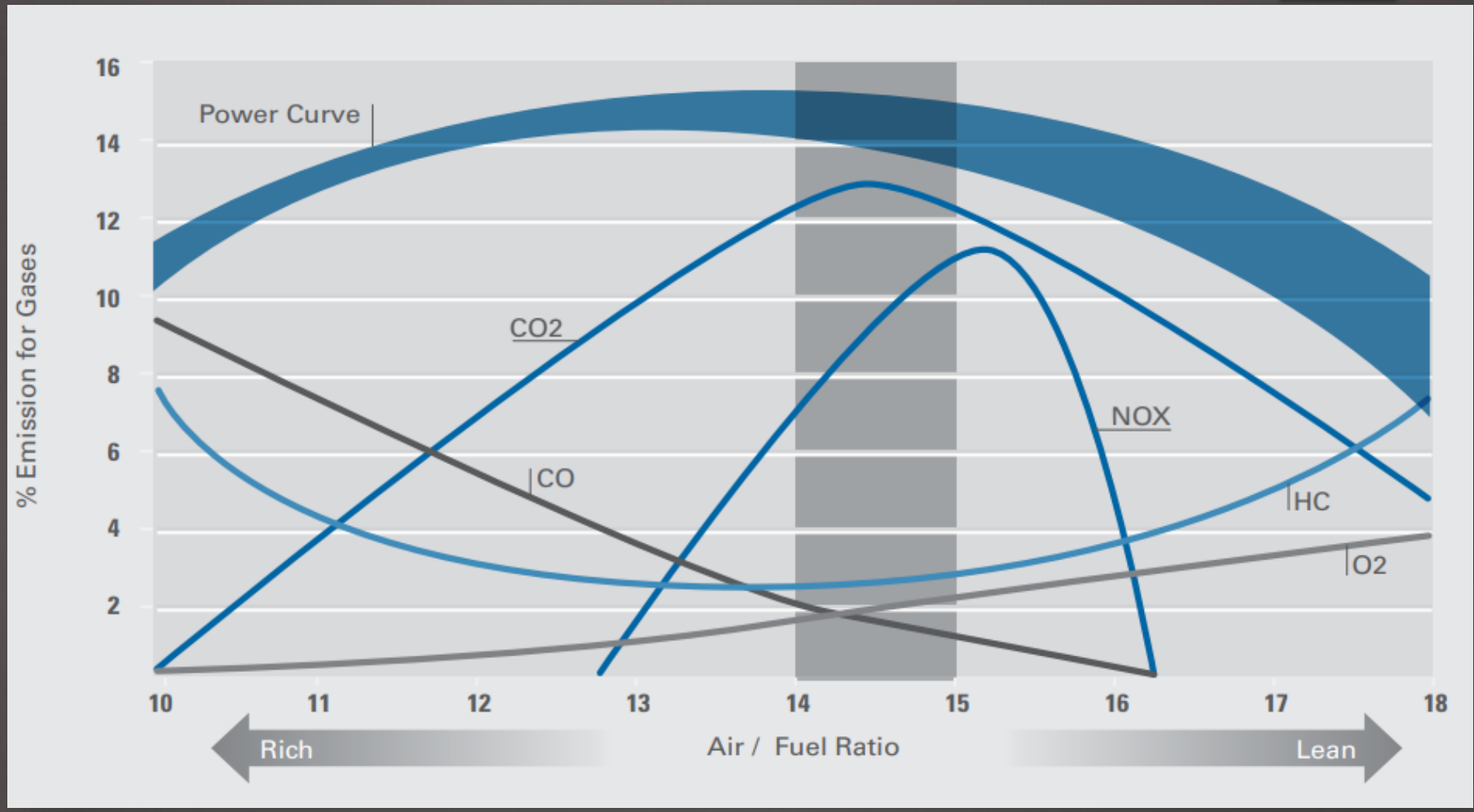
Composition of exhaust emissions of diesel engines

https://autokult.pl/9882,spaliny-silnikow-co-zawieraja-i-jak-to-wplywa-na-czlowieka-2

N_2	Nitrogen
O_2	Oxygen
H_2O	Water
CO_2	Carbon dioxide
CO	Carbon monoxide
NO_X	Nitrogen oxides
SO_2	Sulphur dioxide
Pb	Lead
HC	Hydrocarbons
Particulate matter (PM)	

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

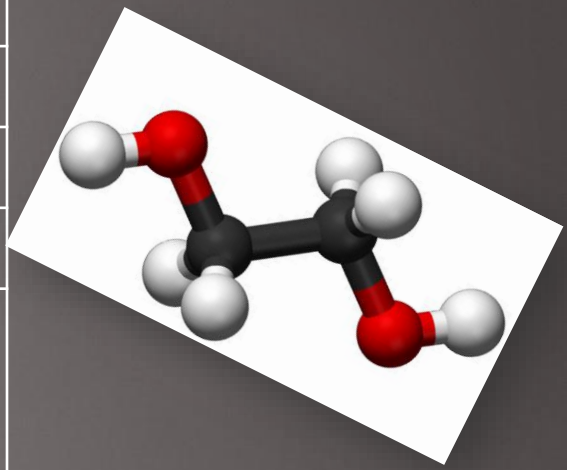
Toxic compounds



Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

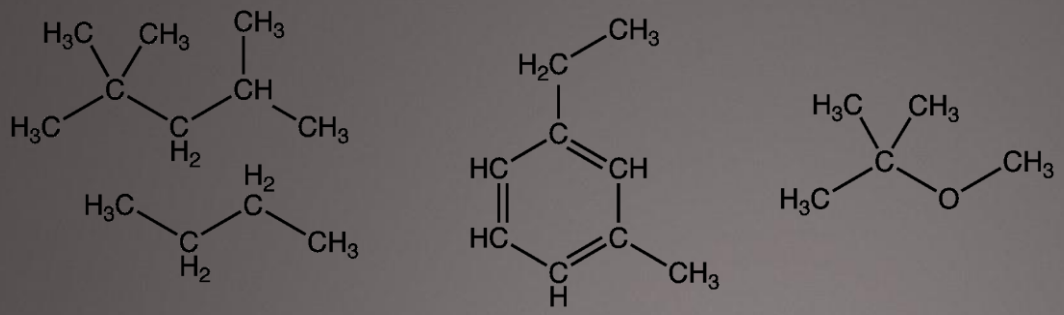
Basic Pollutants

Pollutant	Abbreviation	Type
Carbon Monoxide	CO	Primary
Sulfur Dioxide	SO_2	Primary
Ozone	O_3	Secondary
Nitrogen Dioxide	NO_2	Secondary
Hydrocarbon Compounds (also called VOCs – volatile organic compounds)	HC	Primary & Secondary
Particulate Matter	PM	Primary & Secondary



Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Composition of Exhaust

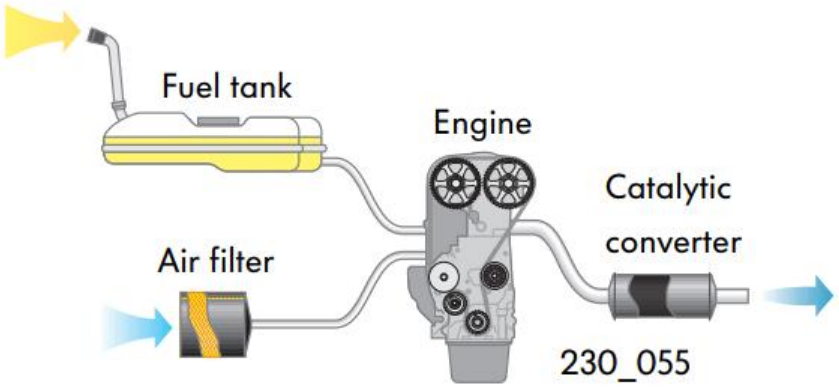


https://en.wikipedia.org/wiki/Gasoline

Some of the components of gasoline: isooctane, butane, 3-ethyltoluene, and the octane enhancer MTBE

HC Hydrocarbons
S Sulphur (impurity)

O_2 Oxygen
N_2 Nitrogen
H_2O Water (atmospheric humidity)



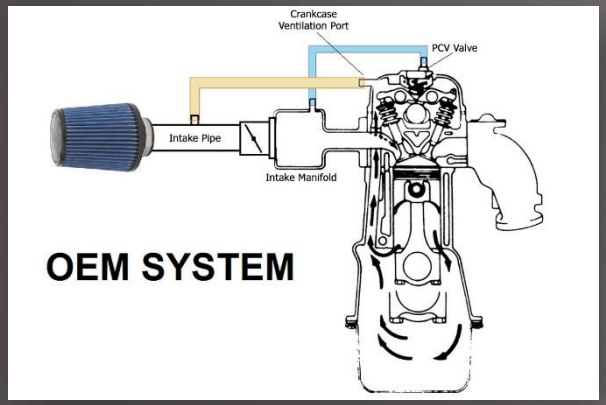
N_2 Nitrogen
O_2 Oxygen
H_2O Water
CO_2 Carbon dioxide
CO Carbon monoxide
NO_X Nitrogen oxides
SO_2 Sulphur dioxide
HC Hydrocarbons
Diesel particulate matter (PM)

www.bosch.com

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

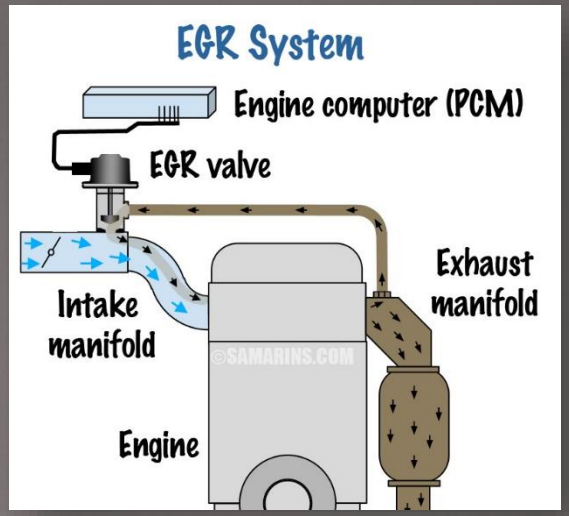
Emision control

Crankcase ventilation



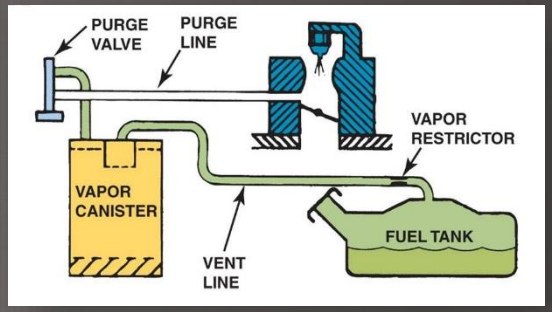
https://www.jbspowercentre.com/wps/wcm/connect/dix+content/newsarticles/tech-articles/enginelabsoilcatchcan

Exhaust Gas Recirculation



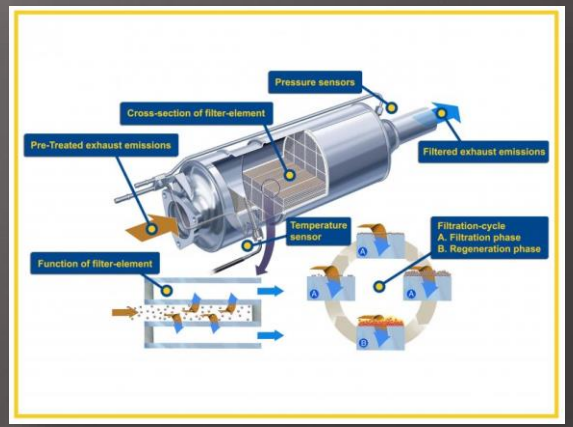
https://www.zhihu.com/question/318553460

Evaporative Controls



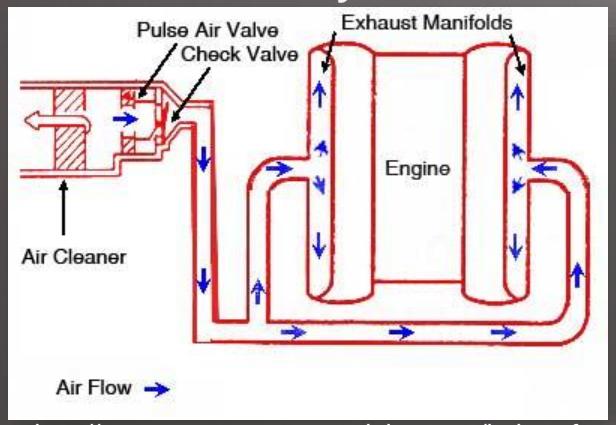
https://pl-pl.facebook.com

DPF diesel particulate filter
GPF gasoline particulate filter
FAP filtre à particules



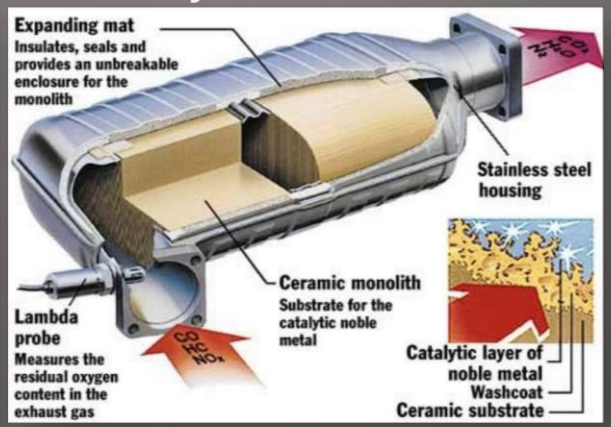
https://kdk.autokult.pl/26040,filtry-czastek-stalych

Pulse air system



http://www.counterpersontraining.com/index.cfm?go=lms.module&moduleid=16&mode=train&topicid=41

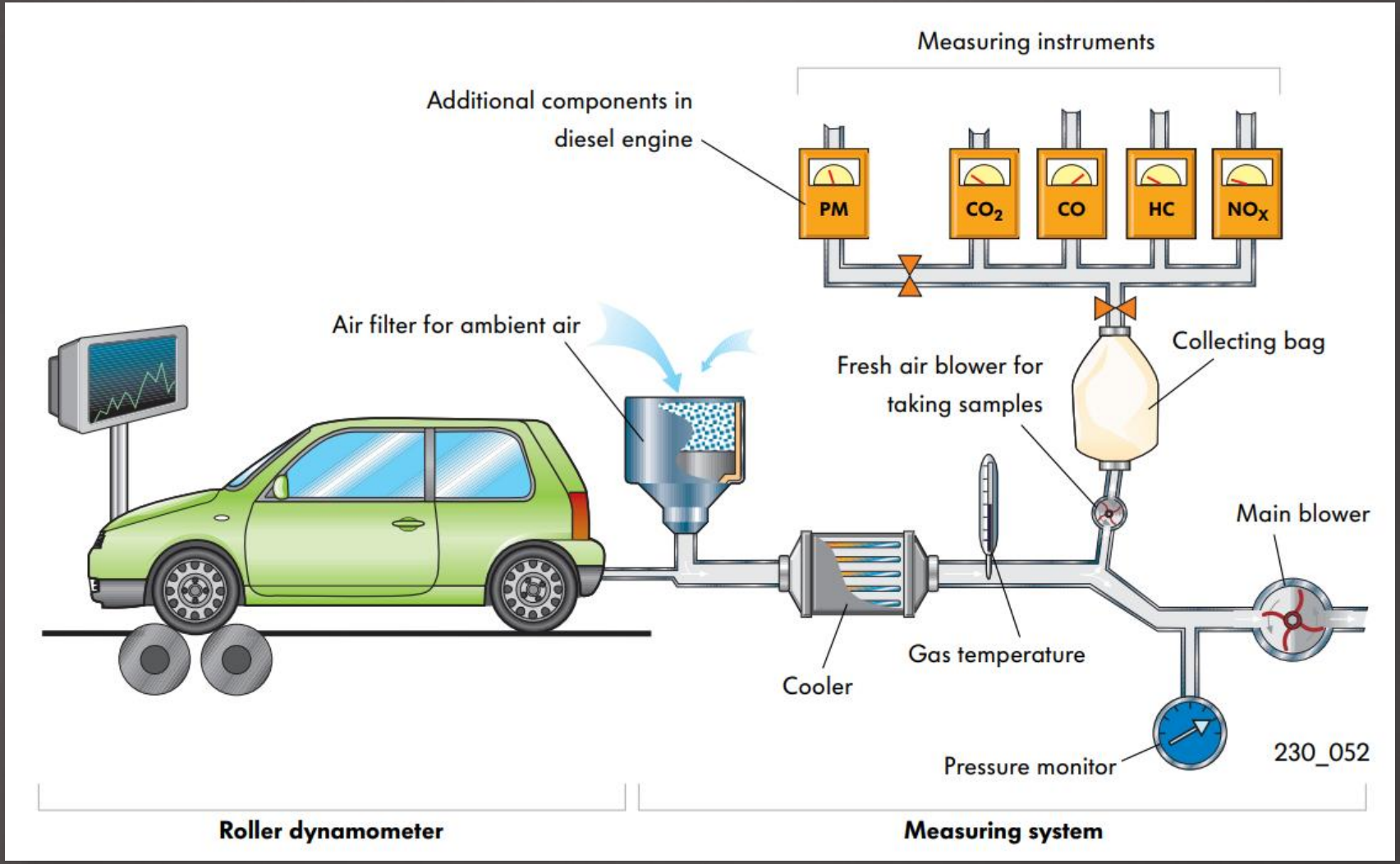
Catalytic Converter



http://katmar.net/czym-jest-katalizator/

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

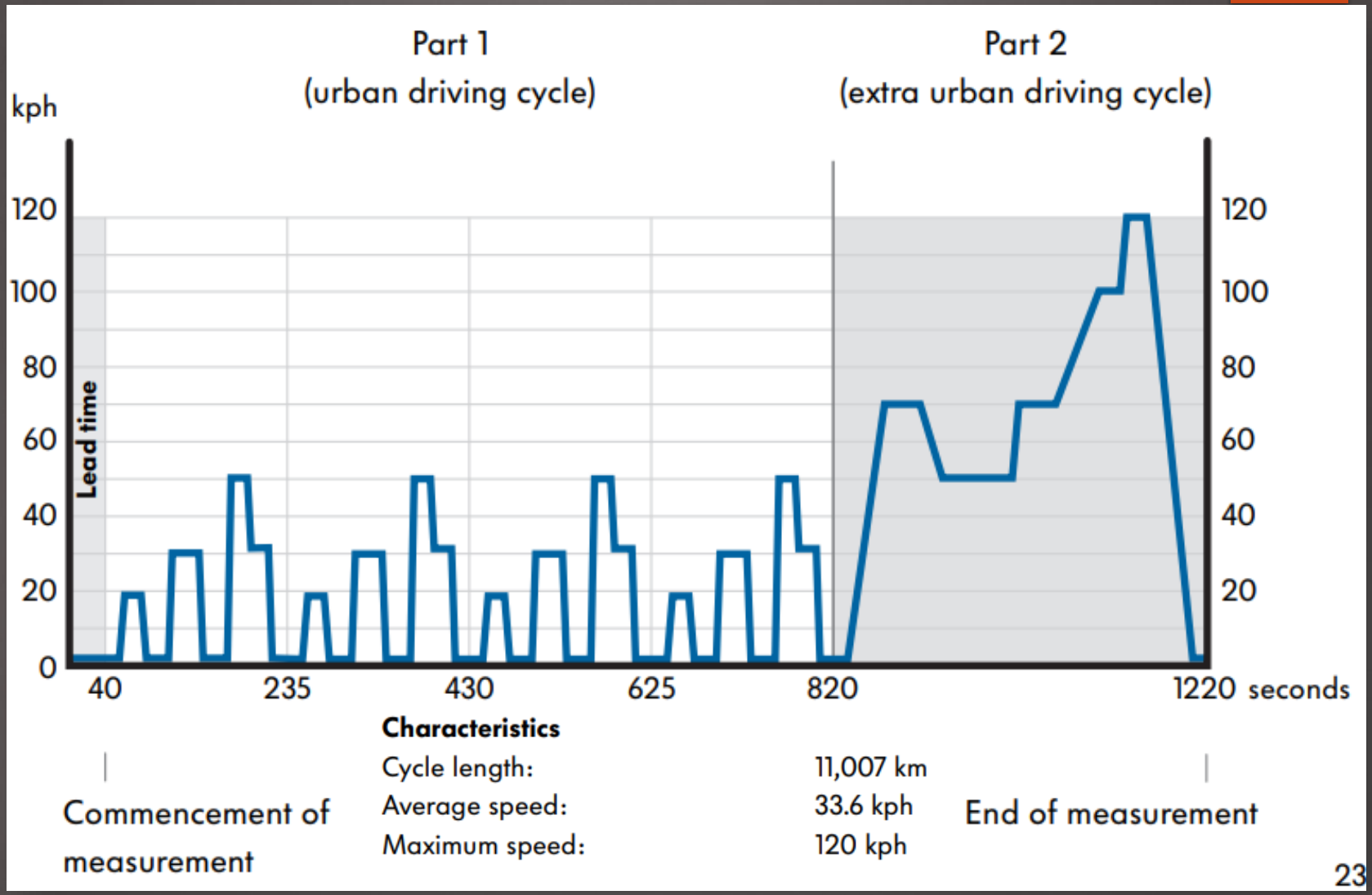
Emision control



www.bosch.com

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Emision control

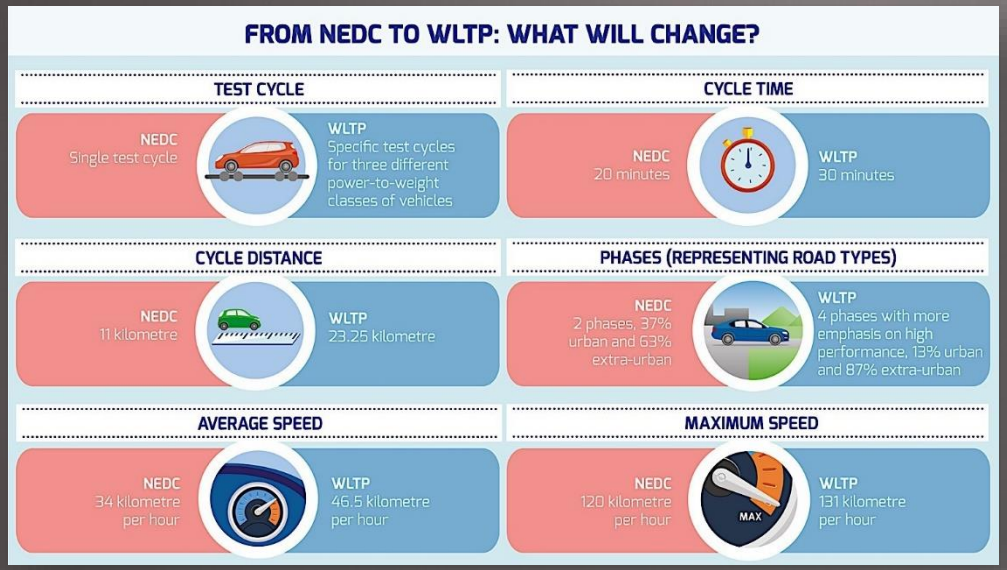


Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

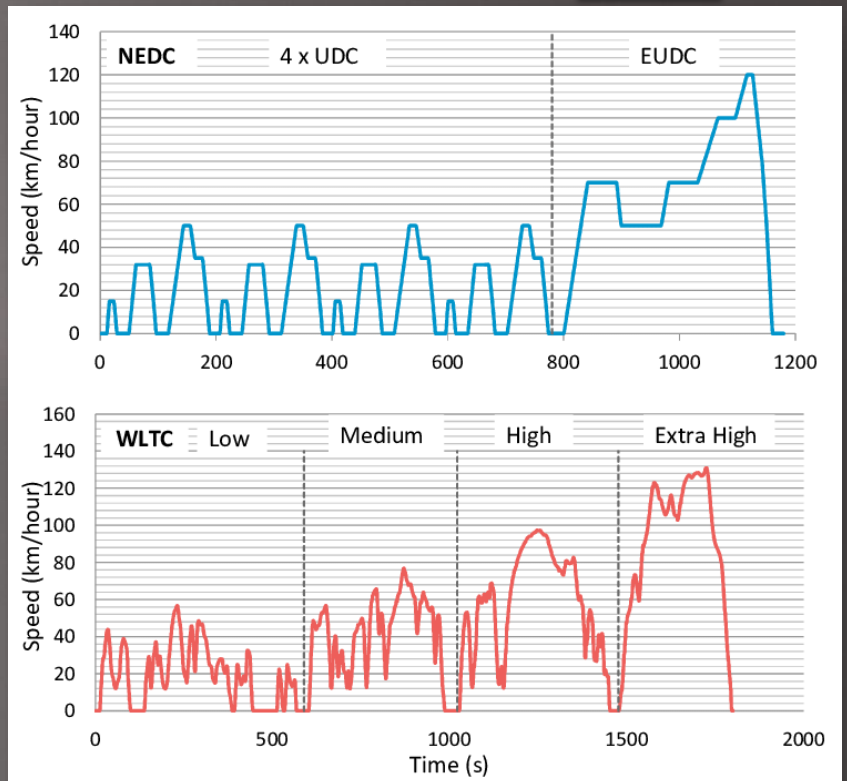
Emision control

From 2017 i Europe the are tests:

- WLTP world harmonized light-duty vehicles test procedure
- RDE real driving test



https://elektrowoz.pl/auta/page/109/

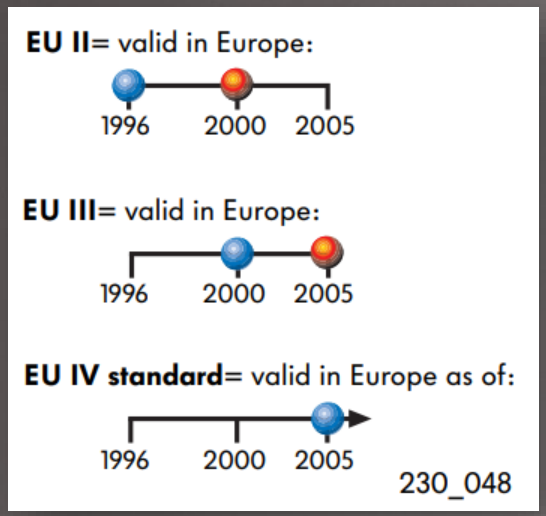


	NEDC	WLTC
Duration (s)	1180	1800
Total distance (km)	11.01	23.27
Average speed (km/h)	33.6	46.5
Maximum speed (km/h)	120	131.3
Stop duration (%)	23.73	13.00

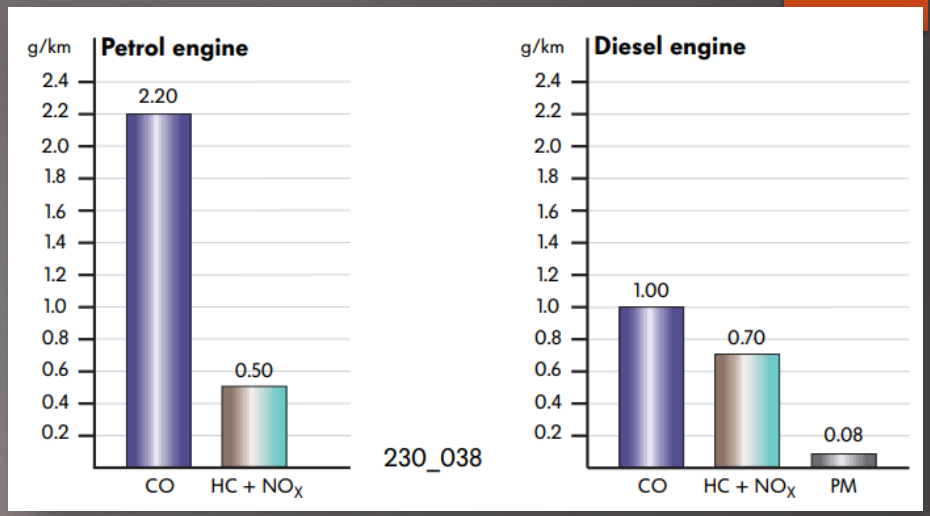
https://www.autoappassionati.it/ciclo-wltp-come-funziona/

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

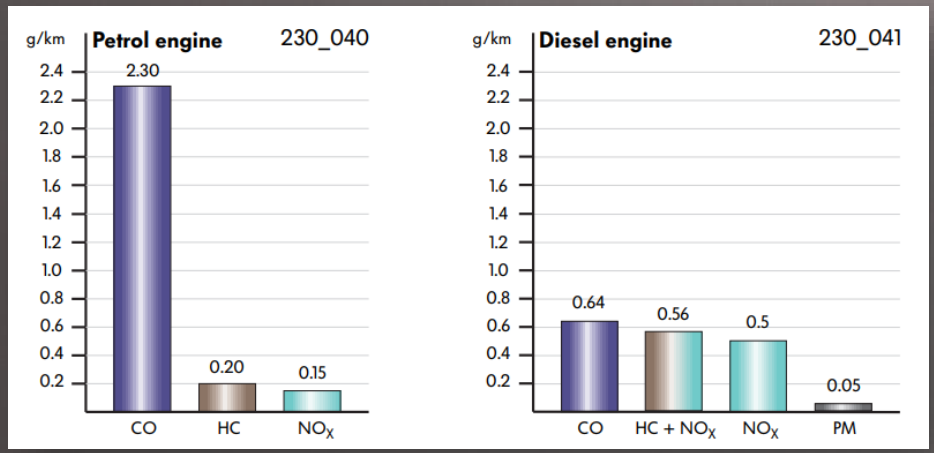
Emision control



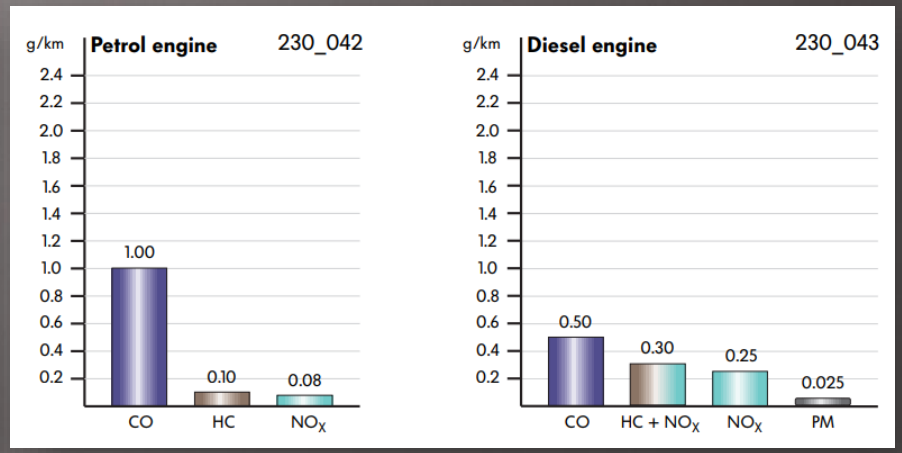
EURO II



EURO III



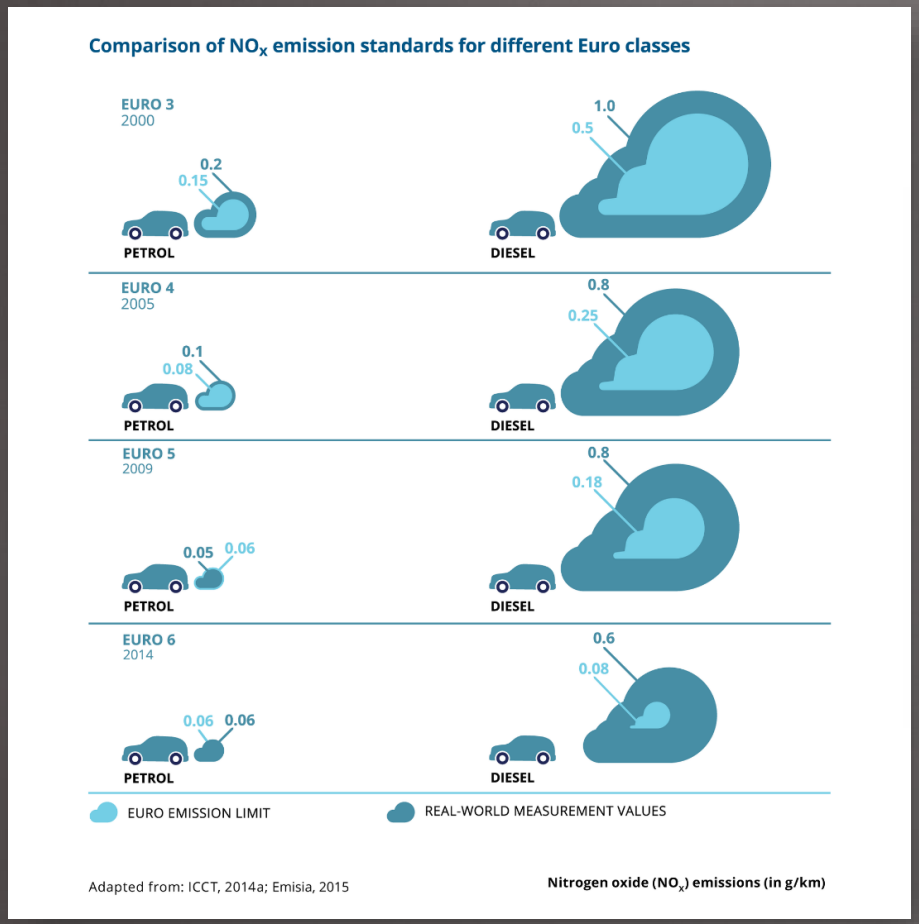
EURO IV



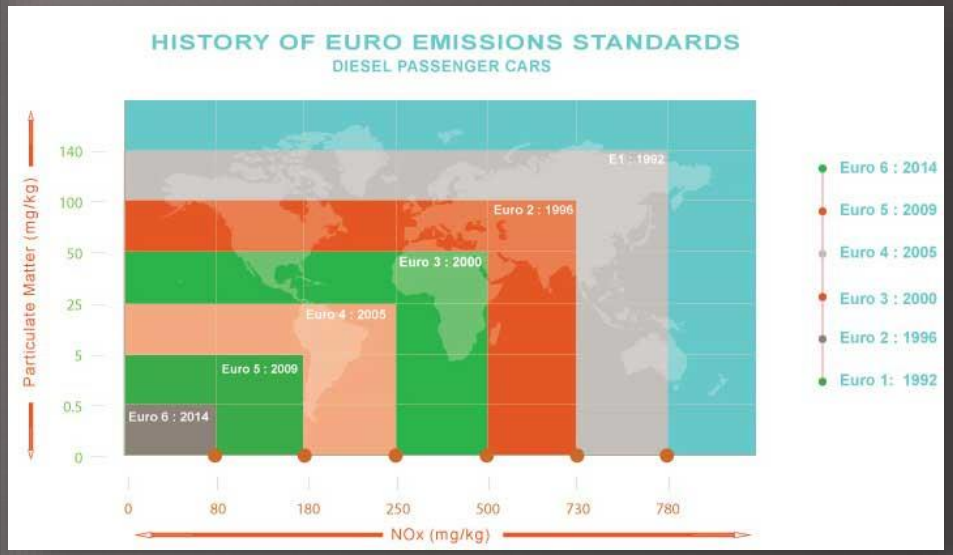
www.bosch.com

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Emision control



https://www.eea.europa.eu/media/infographics/comparison-of-nox-emission-standards/view



https://www.clm.co.uk/blog/euro6-emissions-ad-blue/

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Particulate Matter

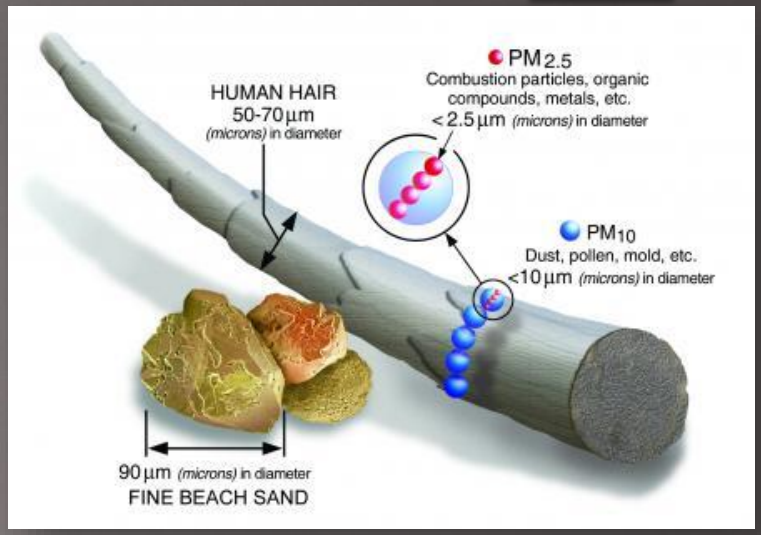
- Complex mixture of solid and liquid particles
- Composed of many different compounds
- Both a primary and secondary pollutant
- Sizes vary tremendously
- Forms in many ways
- Clean-air levels are < 5 µg/m^3 *
- Background concentrations can be higher due to dust and smoke
- Concentrations range from 0 to 500+ µg/m^3 *
- Health concerns
  - Can aggravate heart diseases
  - Associated with cardiac arrhythmias and heart attacks
  - Can aggravate lung diseases such as asthma and bronchitis
  - Can increase susceptibility to respiratory infection

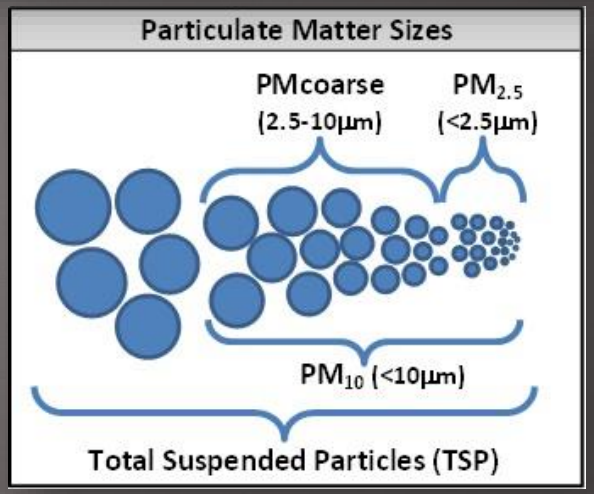
Particle sizes

Ultra-fine particles (<0.1 µm)

Fine particles (0.1 to 2.5 µm)

Coarse particles (2.5 to 10 µm)





https://www4.des.state.nh.us/appc/?page_id=138

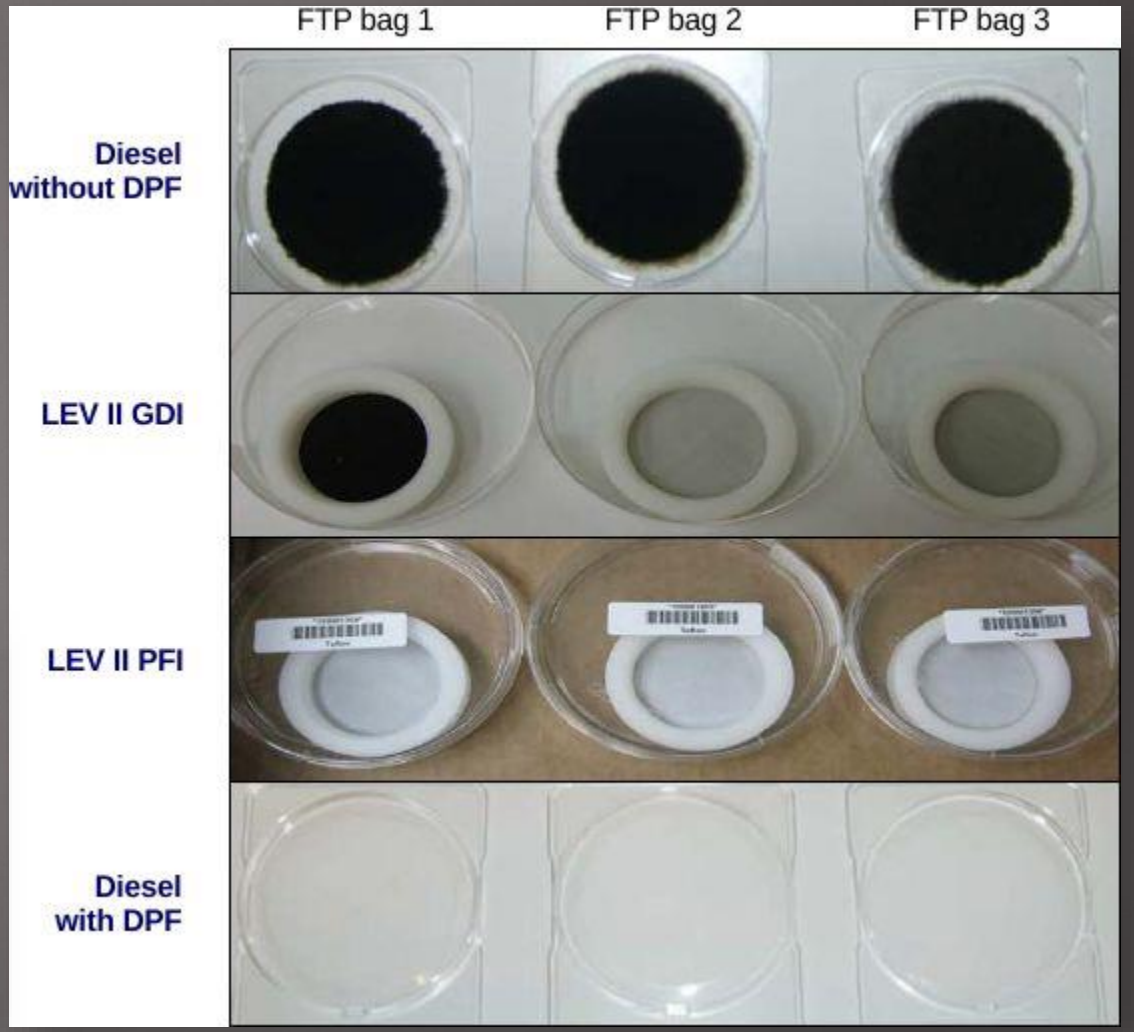
Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Particulate Matter

http://mce2.org/wmogurme/images/workshops/2011/costarica/docs/7_Quimica_Espanol.pdf

A clear (left) and dirty (right) PM filter

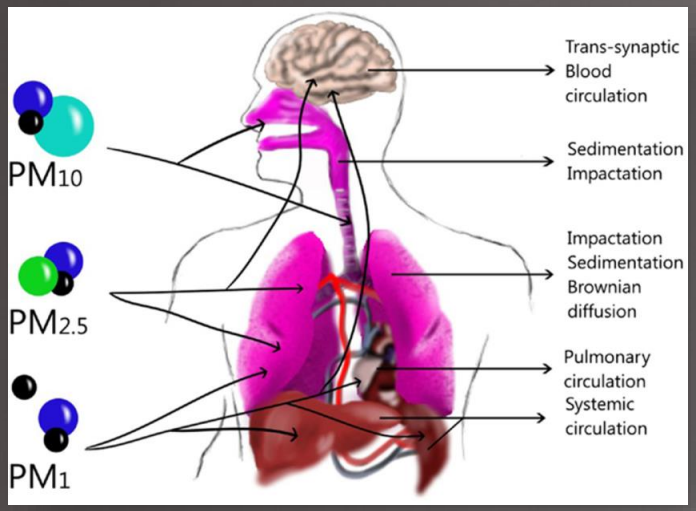
https://dieselnet.com/tech/measure_pm_col.php



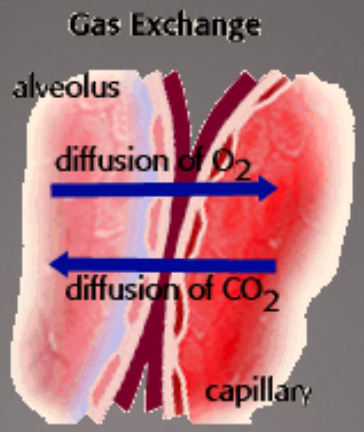
https://dieselnet.com/tech/dpm.php

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

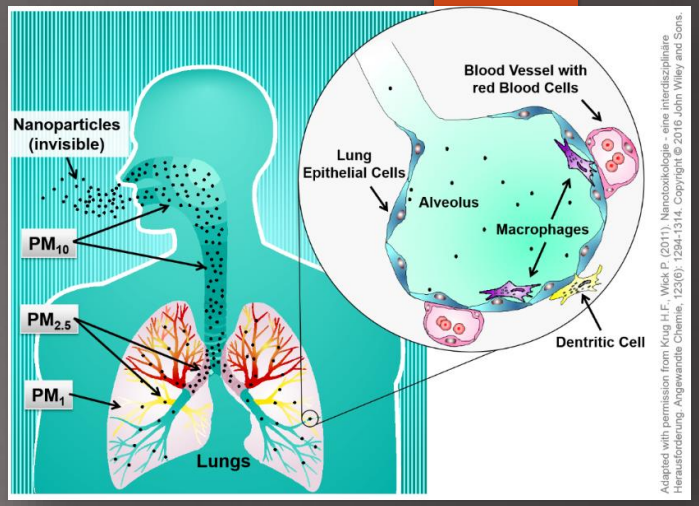
Particulate Matter



https://www.frontiersin.org/articles/10.3389/fimmu.2016.00003/full



http://www.biology.arizona.edu/chh/problem_sets/lung_toxicology/03t.html



https://www.wheatland.k12.ny.us/cms/lib/NY02205799/Centricity/Domain/121/Air%20quality%20in%20the%20environment%20PDF.pdf

https://www.purefrance.com/34484/holiday-chateau

An active area of human loughs is about tenis court.

The amonut of blood spread in this area is about the couple of vine.

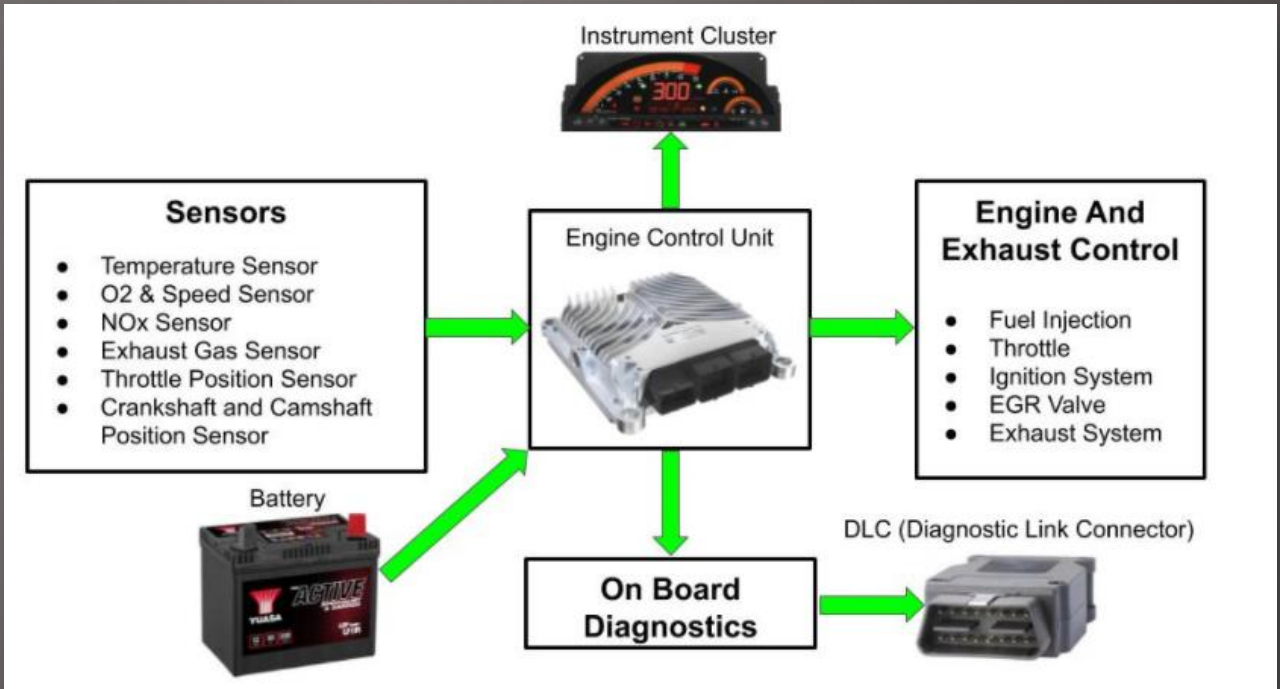
Lets think what is the thikness of this layer.

https://sklep.technica.pl/do-wina

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

OBD

OBD stands for On-Board Diagnostics and is a computer system inside of a vehicle that tracks and regulates a car's performance. The computer system collects information from the network of sensors inside the vehicle, which the system can then use to regulate car systems or alert the user to problems. A technician can then simply plug into the OBD system to collect vehicle data and diagnose the problem.



https://www.noregon.com/what-is-obd/
https://www.smlease.com/entries/automotive/what-is-on-board-diagnostics/

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

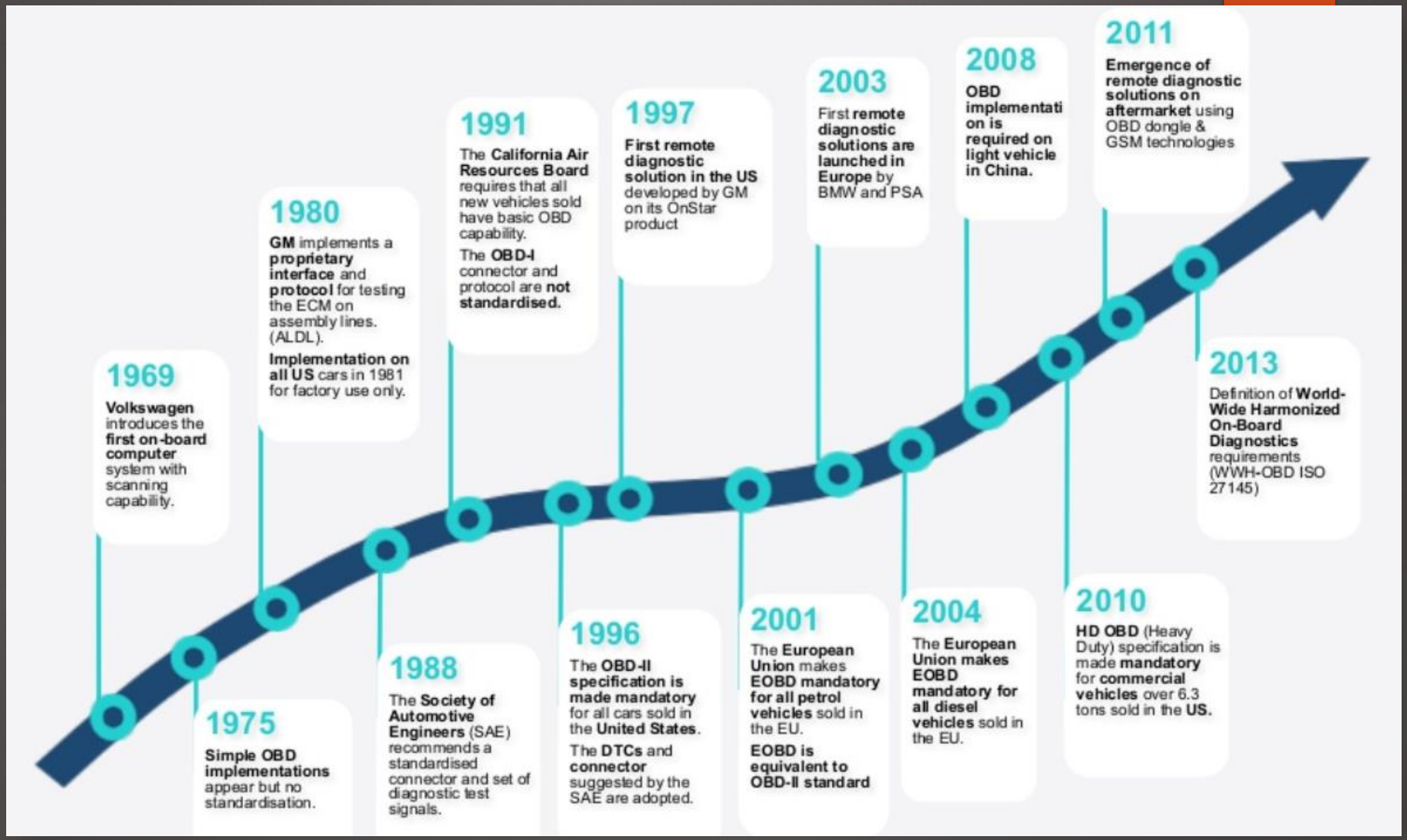
OBD

The scope of functions that must be fulfilled by the OBD system is clearly available by the included. The European EOBD standard is slightly different from the American OBD II.
Requirements that are available in the on-board system

- monitoring the operation of catalytic converters,
- monitoring of solid particles,
- monitoring of oxygen sensors,
- monitoring of ignition loss,
- monitoring of the lack of combustion process,
- power system monitoring,
- air system operation monitoring,
- monitoring the operation of the exhaust gas recirculation system,
- monitoring the operation of the fuel vapor removal system,
- engine system monitoring
- monitoring the operation of the camshaft timing system,
- saving engine working conditions,
- controlling the lighting of the MIL control lamp,
- support for a standard diagnostic connection,
- protection against unauthorized system modifications,
- gearbox function monitoring.

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

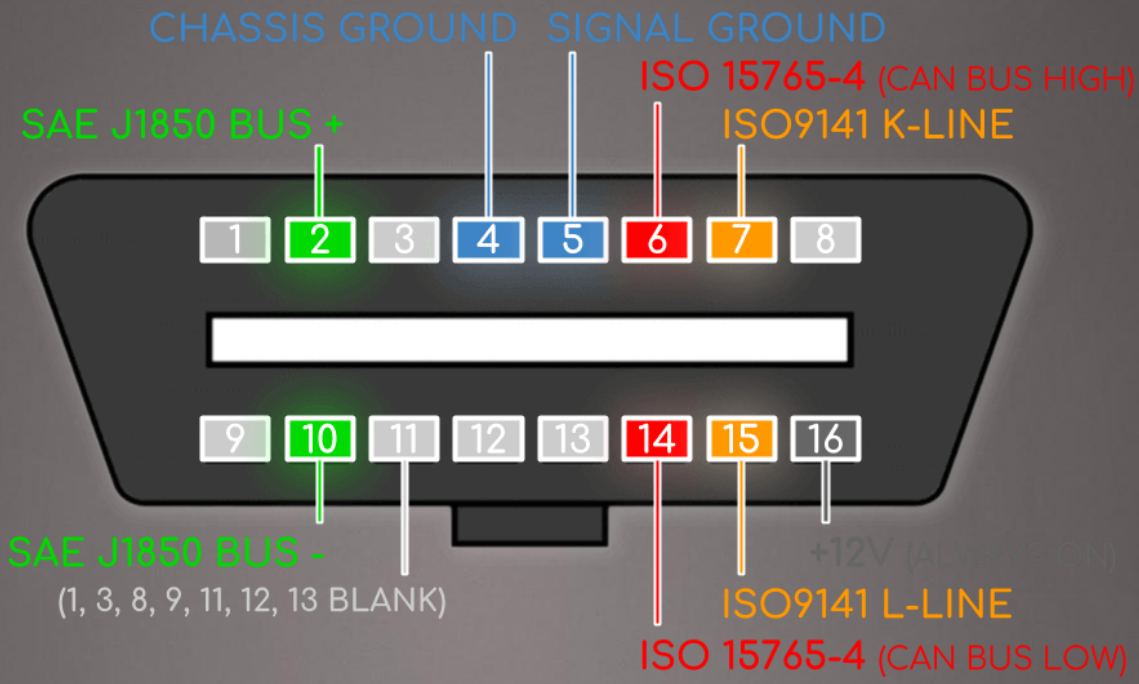
OBD - history



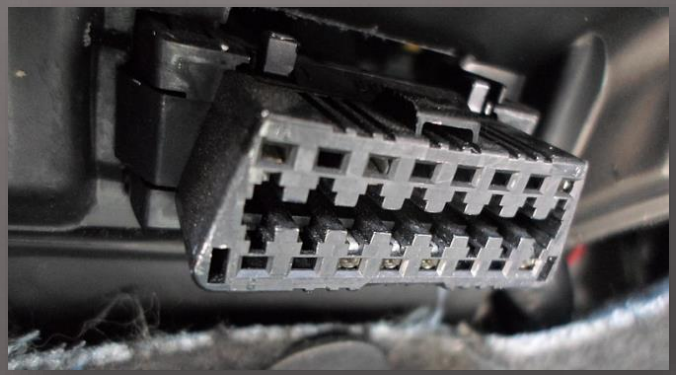
https://www.slideshare.net/dgeethom/the-role-obd-in-usage-based-insurance-in-2015

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

OBD - plug



https://www.csselectronics.com/screen/page/simple-intro-obd2-explained/language/en



https://www.makeuseof.com/tag/obd-ii-port-used/

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

OBD - diagnostic tools

Texa OBD Log

http://www.motodiagnostyka.com/texa-obd-log-mobilny-czytnik-normy-eobd-p-478.html

https://txs.sell.everychina.com/p-109025479-texa-navigator-txts-commercial-heavy-truck-diagnostic-scanner-device-tools-for-exotic-cars.html

Texa Navigator

ELM 327

https://krzymark.pl/skaner-interfejs-diagnostyczny-elm-327-zlacze-obd-2-wifi-komputer

https://allegro.pl/oferta/multidiag-pro-2020-tester-interfejs-diagnostyczny-7902205377

Multidiag Pro

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Classification of emission elements

Group A Elements of the highest emission risk

- combustion process (detection of ignition loss)
- catalytic reactor
- oxygen sensors
- EVAP vapor extraction system

Group B Elements of medium emission risk

- EGR exhaust gas recirculation system
- additional (secondary) air system
- mix composition control system
- PVC crankcase ventilation system

Group C Elements of potential emission risk

The not included in groups A and B and includes all sensors as well as measurement and executive elements of the propulsion systemgroup of potential emission risk elements includes all other emission elements

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Diagnostic tests of the OBD II system

The following diagnostic tests are carried out in the OBD II system:

- electrical efficiency of measuring and executive elements,
- passive tests of metrological efficiency of measuring elements,
- active tests of metrological efficiency of measuring elements,
- emission elements and systems of vehicles,
- functional actuators.

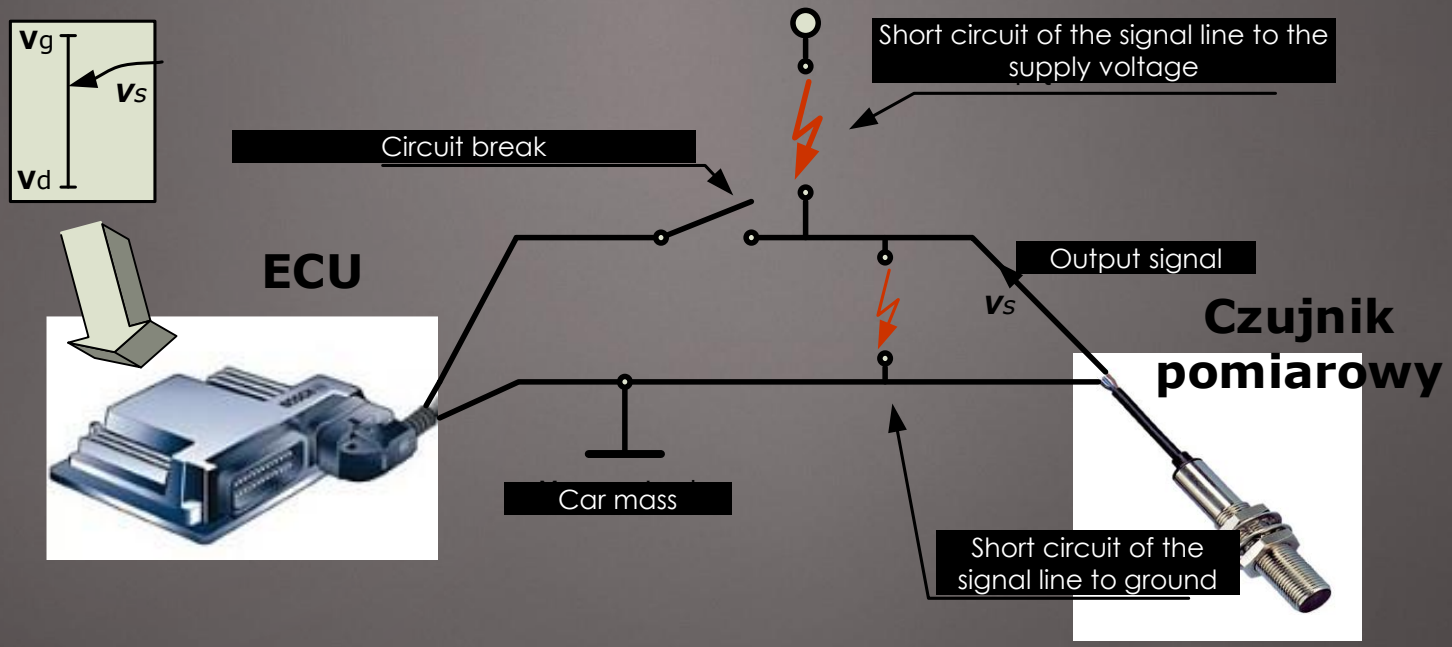
https://download.komputerswiat.pl/akcesoria-i-narzedzia/diagnostyka/obd-auto-doctor

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Diagnostic tests of the OBD II system

Electrical efficiency tests

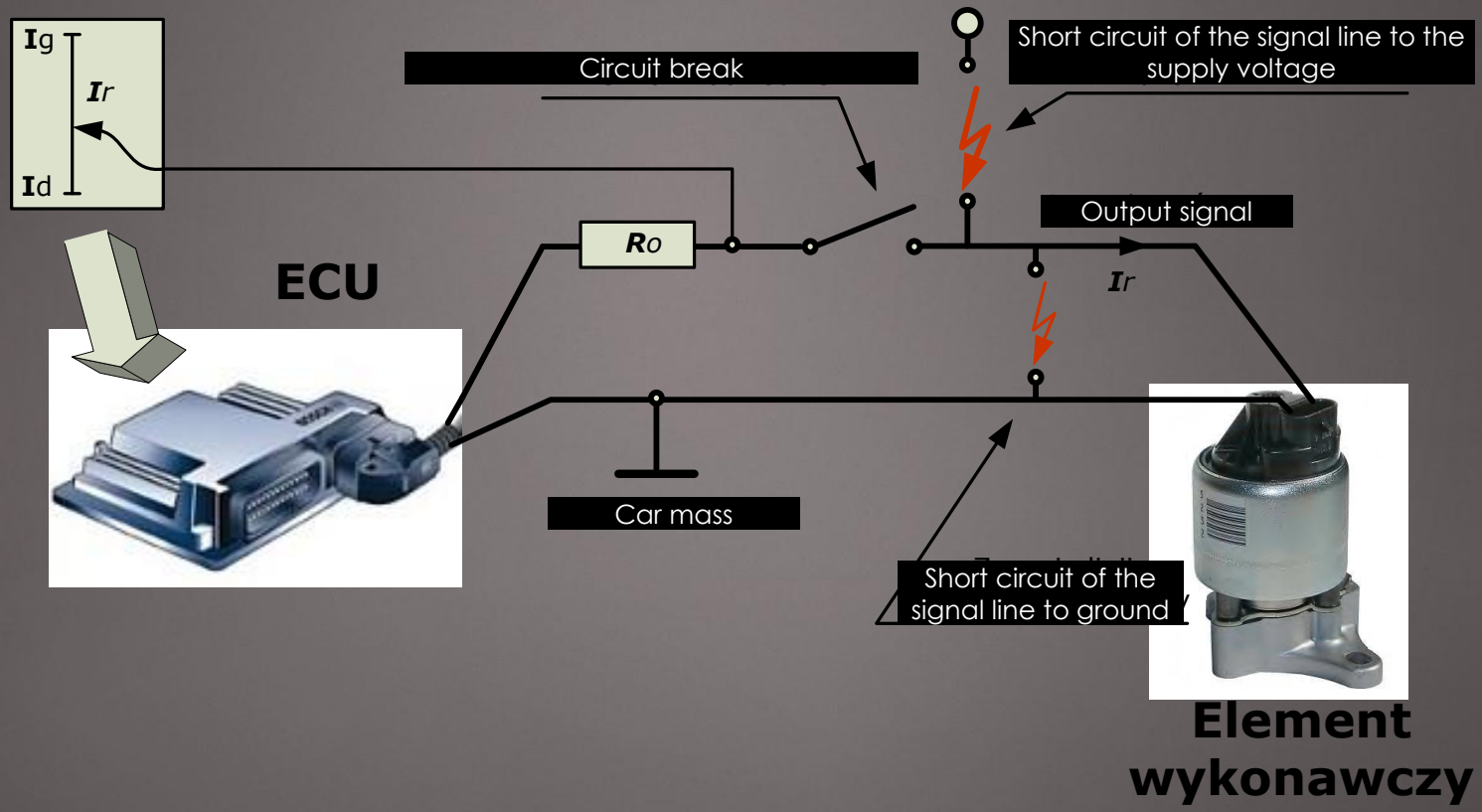
Electrical efficiency tests include checking the continuity of the measuring circuit, short circuits in the sensor signal line or supplying the actuator to the vehicle ground or supply voltage. The task of the electrical efficiency test is also to compare the voltage from the sensor with the manufacturer-defined limits.
In the case of tests of actuators, the current flowing to the element, whose value is a diagnostic parameter of its technical condition, is additionally measured.



Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Diagnostic tests of the OBD II system…

Electrical efficiency tests



Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Diagnostic tests of the OBD II system

Passive metrological fitness test

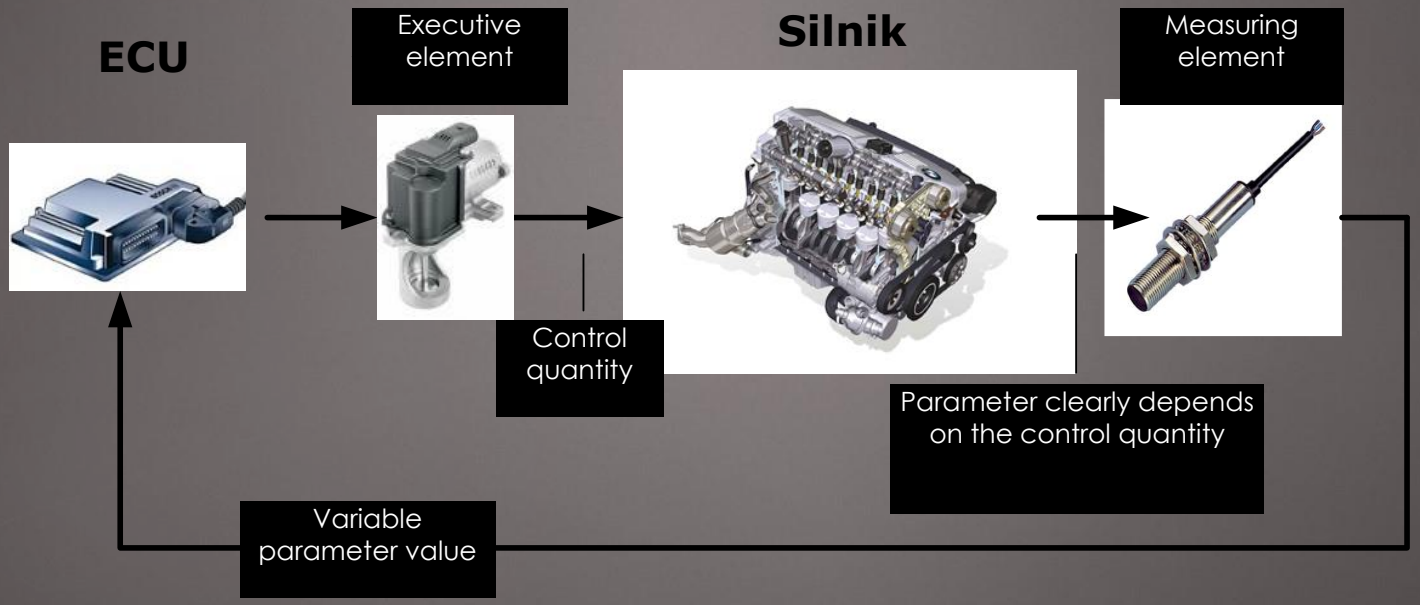
This test is a diagnostic procedure consisting in checking the correctness of the tested sensor indications based on a comparison of these indications with the so-called an area of rational indications.
The area of rational indications is calculated on the basis of other physical values of the propulsion system

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Diagnostic tests of the OBD II system

Functional test

The functionality test refers to the executive elements and consists in active testing of the efficiency of the element by means of deliberate stimulation with a known test signal



Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Diagnostic tests of the OBD II system

Active metrological test

The course of the active metrological test is similar to the course of the functional test, however, in this case the measuring element is tested by forcing known changes in the quantities measured with the help of the control quantity affecting them, assuming that the executive element changing this size works correctly. Such a test allows, among others, to determine the dynamic properties of the sensors.

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Diagnostic tests of the OBD II system

Emission tests

A characteristic feature of emission tests is the following criterion of efficiency of the diagnosed element or system.

An element or system is considered damaged if one alone causes an increase in HC, CO, NOx emissions above the thresholds defined in the standard. Both the emission value and the thresholds are expressed in g / km and measured by the applicable test. Otherwise, the element or system is considered functional.

Estimation of the emission efficiency defined in this way requires the implementation of complex control and measurement, calculation and decision procedures. Hence, emission tests are referred to in the OBD standard as diagnostic monitors.

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Diagnostic monitors

The monitor is a diagnostic procedure responsible for controlling and observing the components assigned to it. Each vehicle module (driver) has one or more such procedures built-in. There are two groups of monitors: continuous and discontinuous.

One of the parameters read from the OBDII / EOBD system is the status (status) of diagnostic monitors. The following settings are possible:

- unavailable - no monitor installed
- ready - monitor finished, no faults detected
- not ready - monitor has not finished or a fault has been detected
- active - monitor during the performance of a given driving cycle
- inactive - the monitor does not perform in a given driving cycle

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Main diagnostic monitors

The scope of operation of the main OBD II / EOBD emission monitors includes the control of the efficiency of the catalytic converter, the correctness of the combustion process (ignition loss), the EVAP fuel vapor removal system and oxygen sensors.

The main emission monitors are a standard set that must be included in every OBD II system, regardless of its configuration and detailed engine design solutions.

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Combustion monitor

Engine malfunction, consisting of the lack of combustion in individual cylinders is described by "loss of ignition" which may be caused by:

- no ignition spark,
- lean mixture,
- too low compression or other cause

This failure always leads to increased emissions from the exhaust system and may cause irreversible damage to the catalytic converter as a result of overheating.

The combustion process monitor and in particular the identification of ignition loss is one of the most important diagnostic procedures of the OBD II system

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Methods for detecting ignition loss in OBD systems

- analysis of the instantaneous value of the angular speed of the motor shaft
- analysis of the instantaneous pressure of the exhaust gases of the engine
- measurement and analysis of the ionization signal in the combustion chamber
- torque measurement and analysis
- analysis of optical signals registered in the engine's combustion chamber

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Catalytic converter efficiency monitor

Catalytic converter efficiency monitors used in OBD II systems use the information contained in the signals generated by two oxygen sensors placed in the exhaust gas stream upstream and downstream of the catalytic converter.
The principle of operation of these procedures is based on the assessment of the oxygen capacity of the catalytic converter, carried out on the basis of analysis of AFR signals from both sensors. Oxygen capacity is the basic diagnostic parameter demonstrating the efficiency of the catalytic converter.

Several methods are used to estimate the oxygen capacity of the catalytic converter:

Ford - oxygen capacity is estimated based on the ratio of the number of sensor switches after the ZK catalytic converter to sensor switches before the PK catalytic converter.

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Monitoring of oxygen sensors in the OBD II / EOBD system

Monitoring the operation of the oxygen sensor installed upstream of the catalytic converter

The oxygen sensor is diagnosed by analyzing the obtained voltage signal waveform. Natural aging processes and damage caused, for example, by the use of lead-containing fuel leads to specific changes in the recorded signal waveform. Minor changes not exceeding the specified range are compensated by the controller.

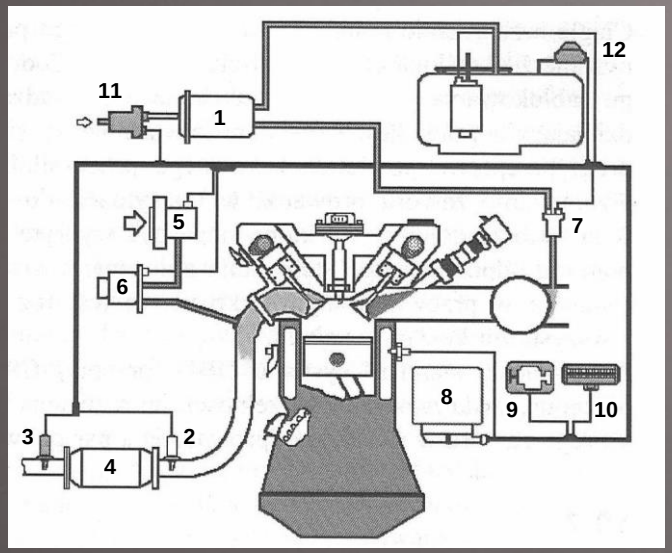
Diagnostic procedures monitoring the oxygen sensor operate cyclically, the condition for their implementation is to preserve the engine conditions as constant as possible - driving at a constant speed for a period of at least 20 seconds. During this time, the sensor signal is analyzed, its frequency and times of low and high voltages are calculated.

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

On-board leak diagnosis systems

Construction of the EVAP system

The purpose of the EVAP system is to reduce hydrocarbon emissions due to evaporation
and the release of light fractions of fuel contained in the tank to the atmosphere.



Rokosch: Układy oczyszczania spalin

Engine fuel system

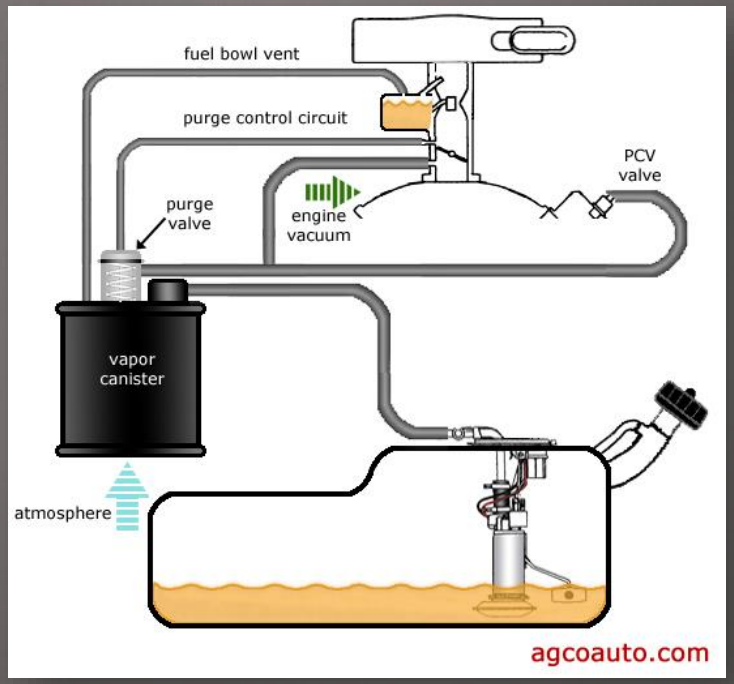
1. Filter - fuel vapor absorber
2. Oxygen sensor in the mixture regulation system
3. Monitoring oxygen sensor - after the reactor
4. Catalytic converter
5. Auxiliary air blower
6. Auxiliary air system valve
7. Fuel vapor flow control valve
8. Motor controller
9. MIL indicator light
10. OBD diagnostic connector
11. Additional EVAP valve for leak detection
12. Fuel vapor pressure sensor in the tank

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

EVAP system monitoring

There are several ways to diagnose a vapor recovery system that involves:

- Control of electrical parameters of the valve controlling the flow of fuel vapors.
- Analysis of the signal received from the oxygen sensor installed in the system engine outlet. The analysis consists in assessing the impact of the absorber operating mode on composition of the mixture burned by the engine.
- Checking the degree of filling of the canister with fuel vapors.



http://www.agcoauto.com/content/news/p2_articleid/294

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

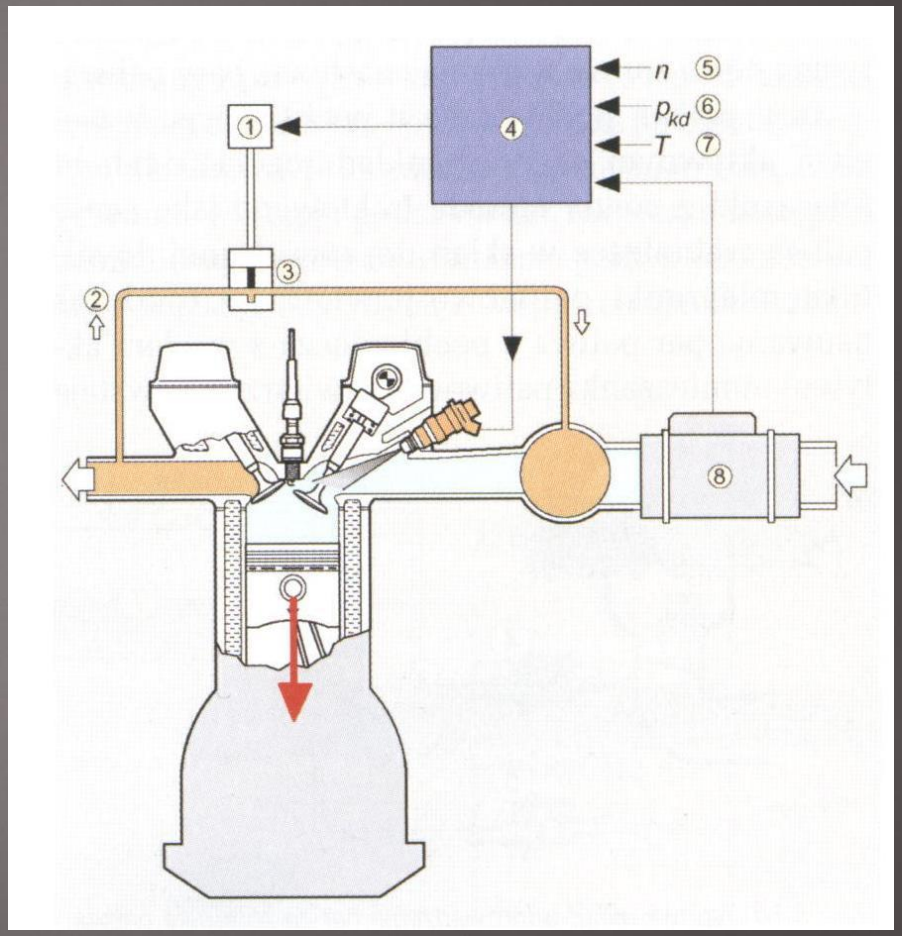
Other diagnostic monitors

EGR exhaust gas recirculation system

The task of the EGR system is to supply some of the exhaust gas back to the engine intake system, which reduces the maximum temperature values occurring during the combustion process, and thus reduces the emission of nitrogen oxides (NOx)

The volume of recirculated flue gas depends on:

- mass or volume of air drawn in by the engine,
- engine coolant temperature
- throttle opening angle,
- absolute pressure prevailing in the intake manifold or exhaust gas overpressure in the exhaust system



Poradnik serwisowy 5/2003

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

EGR exhaust gas recirculation system

The volume of recirculated exhaust gas in relation to the total volume of the load fed into the engine can be:

- in ZI engine - 15-25%
- in ZS engine - 25-50%

The recirculation system works only when the engine reaches the required temperature (approx. 80 ° C) when it operates under steady-state conditions, in the range of low and medium loads

It is not possible to operate the EGR system at idle, even after the engine reaches the required temperature and during acceleration, engine operation under high load, and also during engine braking

An EGR valve that is open at the wrong time (e.g. due to a blockage) causes:

- unstable engine operation
  ignition loss
  increase in exhaust toxicity
  problems starting the engine

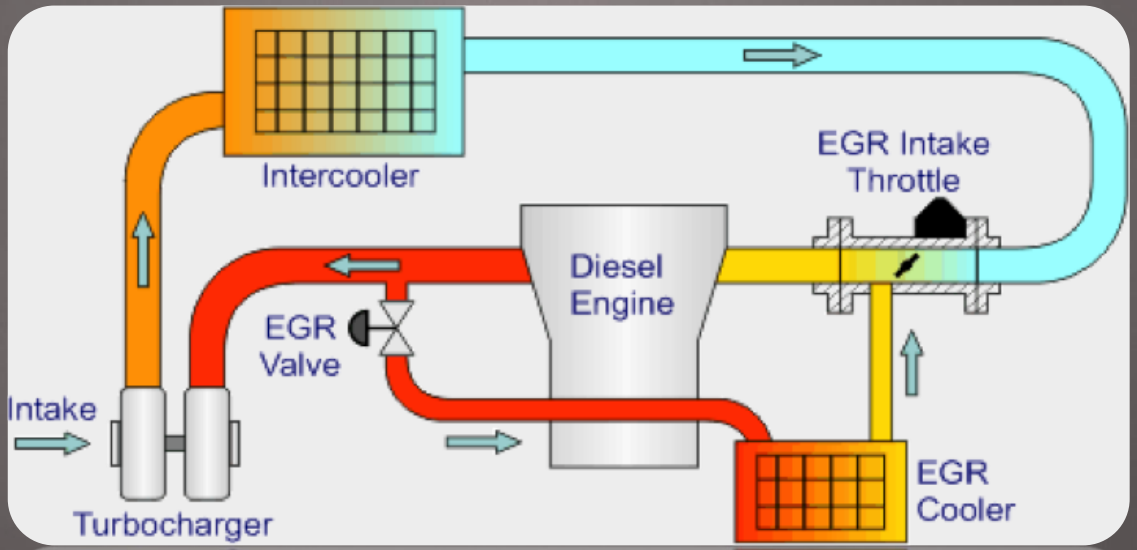
Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Monitoring of EGR exhaust gas recirculation

The EGR monitor test is only activated under certain driving conditions

During the engine braking phase, the exhaust gas recirculation valve opens momentarily. If it is followed by a temporary increase in the absolute pressure in the intake manifold, this is an indication that the recirculation valve is airtight and that it has opened.

Another way to check the tightness of the EGR system is to install an exhaust gas temperature sensor in the valve. The exhaust gas flows after the valve is lifted.



https://klecntek.net.au/engine-reconditioning/egr-anti-pollution-system-reconditioning/

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

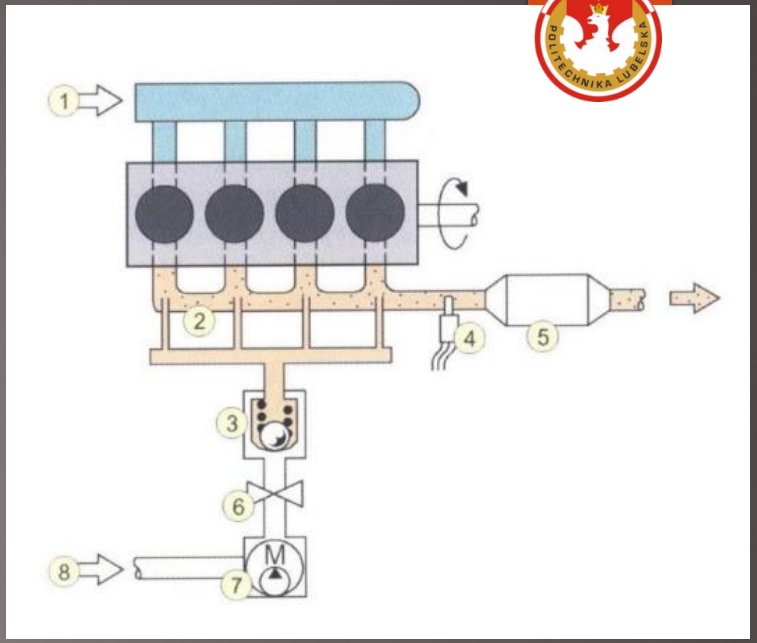
Auxiliary air system

The auxiliary air system is switched on by the control unit directly after starting the engine and during its heating.

Fresh air pumped through the pump is supplied to the engine exhaust system where it mixes with fuel residues in the exhaust gas. Under the influence of heat in the exhaust system, intensive oxidation of carbon monoxide CO and HC hydrocarbons occurs, thanks to which their emission decreases.

The use of an additional air system also accelerates the heating of the catalytic converter to its normal operating temperature

In some systems, additional air is injected directly into the catalytic converter when the engine is cold



Poradnik serwisowy 5/2003

Additional air injection system
1. Air drawn in by the engine
2. Additional air injection
3. Check valve
4. Lambda probe
5. Catalytic converter
6. Additional air shut-off valve
7. Additional air pump
8. Atmospheric air

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Auxiliary air system monitoring

The task of the auxiliary air system monitor is to test its components for functional, mechanical and electrical correctness. The control covers the operation of the air pump and valve.

The conditions that must be met to run system monitoring depend on the engine type and manufacturer.

The diagnostic procedure consists in short-term, purposeful enrichment of the mixture composition, and then the activation of the additional air system. If the system works properly and supplies additional air to the flue gas, the oxygen it contains changes the signal of the oxygen sensor installed in front of the catalytic converter.

The course of the diagnostic procedure is therefore the registration of the signal from the oxygen sensor, if the signal is outside the range of normal values, an additional air system fault is recognized.
Monitoring of individual elements of the fuel system is aimed at detecting possible defects that could disturb the process of controlling the composition of the mixture, thereby leading to an increase in exhaust emissions. These defects may consist of damage:

- pressure regulator (incorrect fuel pressure before injectors)
- injectors (leaks)
- fuel pumps

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Fuel system monitoring

Detection of fuel system leaks

The European EOBD system does not provide for the obligation to carry out diagnostic procedures to check the tightness of the fuel system.
However, it is required to use solutions that prevent the loss of the fuel cap closing the filler neck.

Adaptation of the mixture composition regulation system

Modern power supply systems ensure automatic adjustment of the amount of fuel injected to the prevailing environmental conditions and the individual characteristics of individual engine units.
The advantage of such systems is the ability to adapt to operating conditions, changing among others due to the progressive wear of the engine components.
Auto-adaptation mechanisms allow the fuel dose to be adjusted in the entire range of engine speeds and loads to achieve the desired composition of the fuel-air mixture, close to stoichiometric.
The autoadaptation process consists of two mechanisms for correcting the opening time of injectors, the effects of these mechanisms overlap, resulting in correction of the injector opening time.
The correction mechanisms are:
STFT *(**S**hort **T**erm **F**uel **T**rim)*
LTFT *(**L**ong **T**erm **F**uel **T**rim)*

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Fuel system monitoring

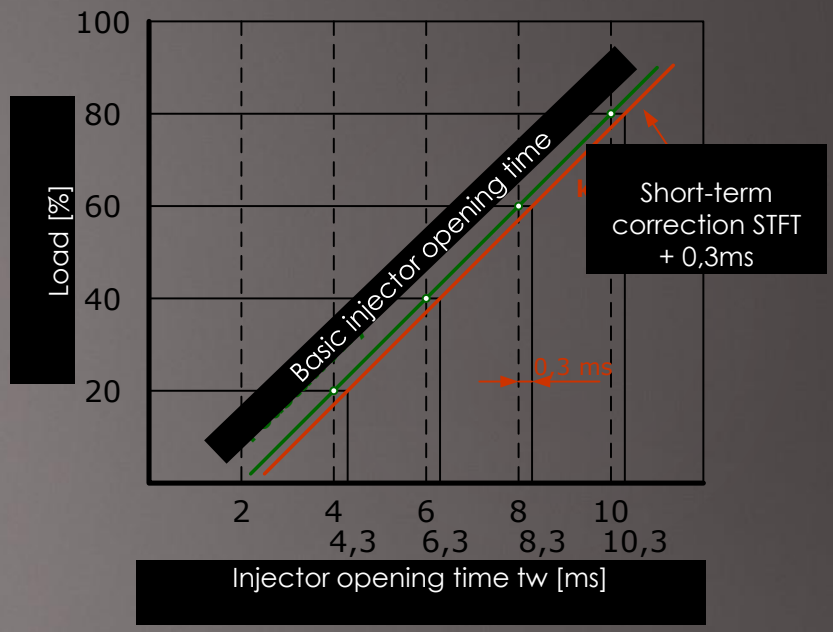
Short-term correction of fuel dosage

The short-term correction mechanism is based on tracking the oxygen sensor voltage and introducing such changes in the injector opening time that the excess air ratio reaches λ = 1.

The operation of this mechanism is particularly important for ensuring the correct operation of the engine and exhaust gas aftertreatment system at idle and low load conditions.

The short-term correction factor is a constant value (positive or negative), contained in a certain predetermined range, by which the injector opening time is extended or shortened.

The short-term correction factor is expressed in milliseconds, its value changes constantly during engine operation.



Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

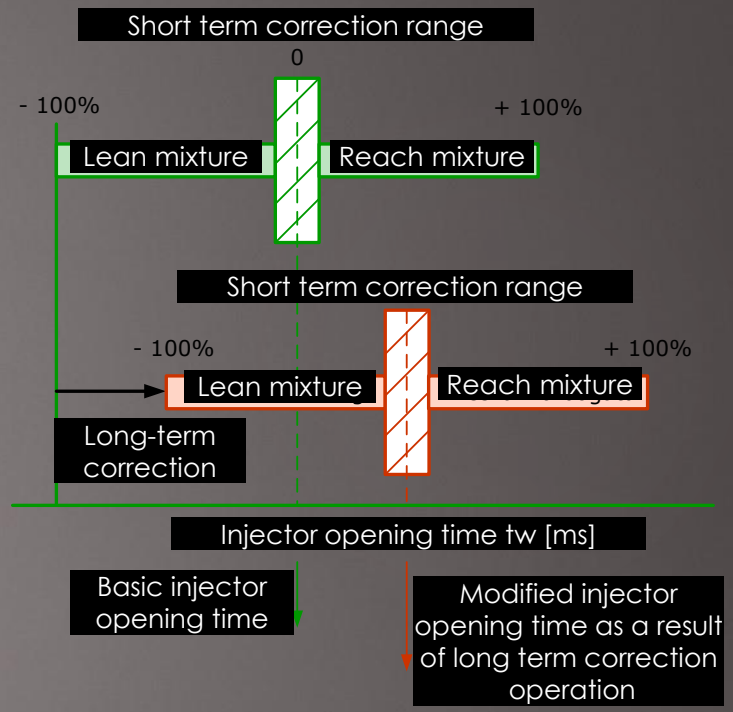
Fuel system monitoring

Long-term correction of fuel dosage

The long-term correction has a decisive impact on the engine's operation in the full range of rotational speeds and loads, except for idling.

The long-term correction factor is dimensionless. The corrected injector opening time is calculated as the product of the basic time resulting from the injection map and the long-term correction factor.

The long-term correction value changes much more slowly than in the case of the short-term correction, the long-term correction allows you to adjust the dose of injected fuel to the individual characteristics of each engine.



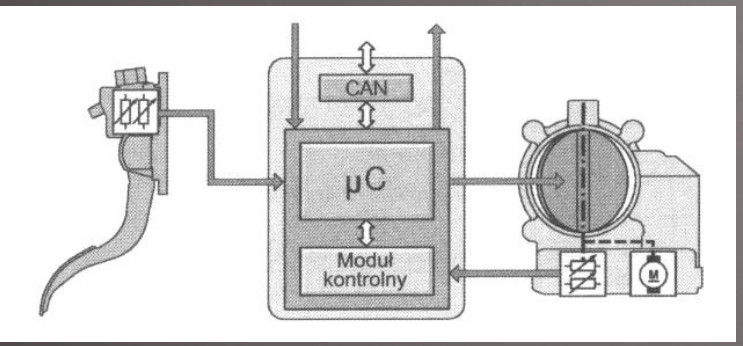
The vehicle manufacturer determines the permissible range of correction factors. The boundaries of this range are selected to ensure the proper adaptation process under all normal operating conditions.

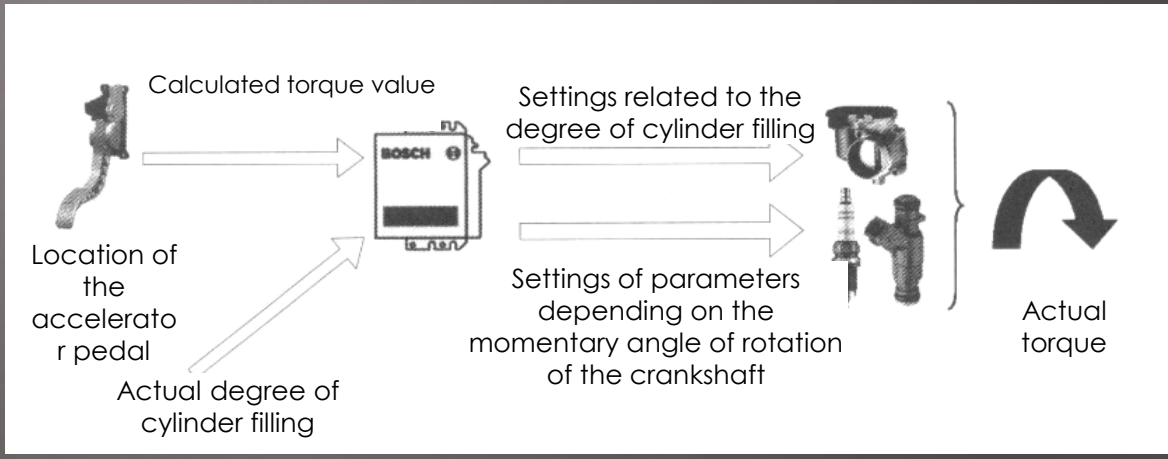
Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Electronic accelerator pedal monitoring

In the latest engine designs, the mechanical connection (via a cable) of the accelerator pedal with the engine throttle is increasingly being replaced by an electronic gas pedal.
The position of the accelerator pedal is recorded using potentiometric sensors or Hall sensors. The actuator is an electric actuator that realizes the desired angle of throttle opening.

For safety reasons, a dual sensor system is always used





Rokosch: Układy oczyszczania spalin

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Electronic accelerator pedal monitoring

In the event of damage to the servomotor controlling the throttle opening angle, an emergency program is implemented, which means that the throttle automatically opens by a specified angle thanks to the initial spring tension, which causes the engine to run at increased idle speed.

In the system with the electronic gas pedal, autonomous diagnostic procedures are carried out, regardless of the OBD system operation, thanks to the use of two independent pedal position sensors. The OBD on-board diagnostics system can take over information about faults detected by the OBD-independent diagnostic system and if the fault repeats in two consecutive driving cycles, the system signals damage by lighting the MIL indicator light.

If a critical fault is detected, e.g. damage to one of the two independent accelerator pedal position recording systems, the control system immediately goes into emergency condition.

The current accelerator and throttle position are the parameters available for reading in the first OBD II scanner operation mode.

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

Monitoring the operation of other systems and sensors

The source of many faults in a passenger car is also the electrical installation.

The types of defects that may occur in the vehicle's electrical system can be divided into the following groups:

- changing the characteristics of the input or output signal
- caused e.g. by an increase in connector resistance,
- breakdown between insulated wires,
- circuit break,
- short to ground.

Other systems subject to OBD monitoring:

- air flow meter,
- boost pressure,
- vehicle speed signal,
- timing system,
- brake and clutch pedal position sensors.

Płatne ze środków Ministerstwa Nauki i Szkolnictwa Wyższego na podstawie umowy nr 030/RID/2018/19 z dnia 19.12.2018 r.

THANK YOU FOR YOUR ATTENTION!!!

Diagnostic of Vehciles M14

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Ministerstwo Nauki i Szkolnictwa Wyższego