Technical Information

Electronics – Oil Sensors

HELLA®

Ideas today for the cars of tomorrow

Oil-level sensors in the vehicle ensure that the engine oil does not become dangerously low without being noticed. The condition of the engine oil is influenced by various factors including individual driving styles and soiling through fuel, soot or water. Oil condition sensors continually monitor the most important properties of the oil and prevent engine damage thanks to early detection of insufficient lubrication ability.

Hella's current product portfolio includes both simple float switches and continually measuring oil level sensors on a thermal basis.

An ultrasonic level sensor, as well as an oil-condition sensor are also available for series projects. An oil-pressure sensor will soon round out the product range.

Micro-system technology as a pioneering technology is the basis of our current new developments. A modular design concept where different oil-sensor functions can be combined without changing the mechanical and electrical interfaces forms the strategic approach for competitive products.

Along with product development, the focus is on the application of the sensor in the overall vehicle system. Supporting our customers in the ongoing development of this system is a major aspect for Hella in securing market leadership in oil-level sensors.

Central development work takes place in Germany. Team-oriented cooperation with customers from the development phase through to series production is guaranteed thanks to our development and sales locations throughout the world.

Float switch

Thermal oil-level sensor

Oil-level sensors

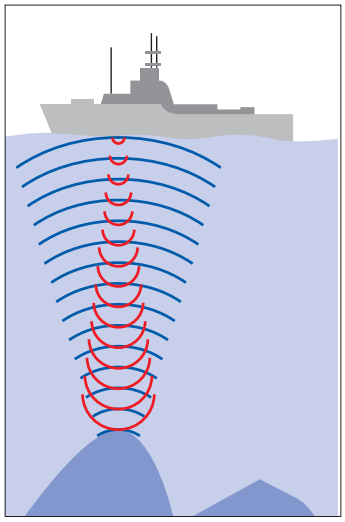
Hella's oil-level sensors map the filling level of the oil continually during trips. An advantage in comparison with the static method is that all marginal influences are compensated by averaging.

Marginal influences include the vehicle being on a slope, the oil flowing back at the end of a journey, lateral and longitudinal acceleration or even dipstick tolerances.

The values determined can be used to signal that the minimum oil level calculated has been reached or to display the current oil level if required.

Current sensors are based on the thermal principle. With this principle, the oil level is derived from the linear connection between the time taken for a sensor element to cool down and the filling level. Future generations work according to the delay principle of ultrasonic sensors. This technology has already been being used successfully for some years in a range of industrial applications. The challenge for the application in oil lies in the special adaptation of wavelength and pick-up characteristics as well as the choice of suitable structure and connection technology.

The oil temperature can be measured by both the current and future sensors and made available as information for further functions in the vehicle.



Echo sounding principle of delay time measurement

Integration concept ultrasonic sensor

A special feature of Hella's ultrasonic sensor is measurement beyond the actual sensor housing. This enables filling levels of up to 150 mm to be measured. Excess filling detection can also be realized. This is the end of the oil dipstick as we know it, with the oil level now being displayed on the dashboard as the driver requires.

An integrated micro-controller in the sensor allows the output signal to be matched to specific customer requirements.

Technical data	
Supply voltage	9–30 V (typ. 9–16 V)
Temperature range	–40 °C to +160 °C
Measuring range	15 mm–150 mm
Accuracy	±1 % F. S.
Temperature measurement	–40 °C to +160 °C
Accuracy (temperature measurement)	±0.5 % F. S.
Electrical interface	Cust. PWM, LIN, CAN

Oil-condition sensor

Flexible maintenance intervals, i. e. based on the respective driving style, are currently based on an algorithm which takes no account of the oil quality.

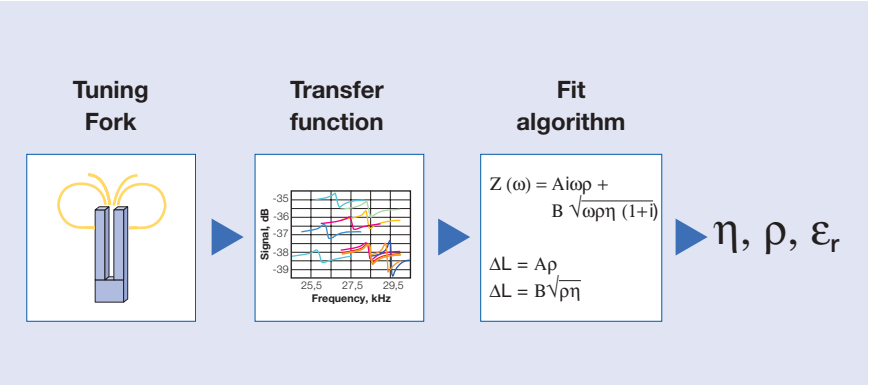
Yet knowledge about the actual oil condition helps
- to guarantee maintenance intervals or extend them even further
- to exploit the oil's service-life
- to prevent possible engine damage through early problem detection

From technical and economic points of view the following parameters can be measured in motor vehicles to determine the condition of the oil:
- Viscosity
- Density
- Permittivity (additional conductivity derivable)

The functional principle of Hella's oil-condition sensor can be described as follows: A "tuning fork" is stimulated over a defined frequency range and its transfer function measured. The mechanical-electrical behavior of this tuning fork can be represented in an electrical equivalent circuit, the equivalent variables of which correspond to the specified parameters.

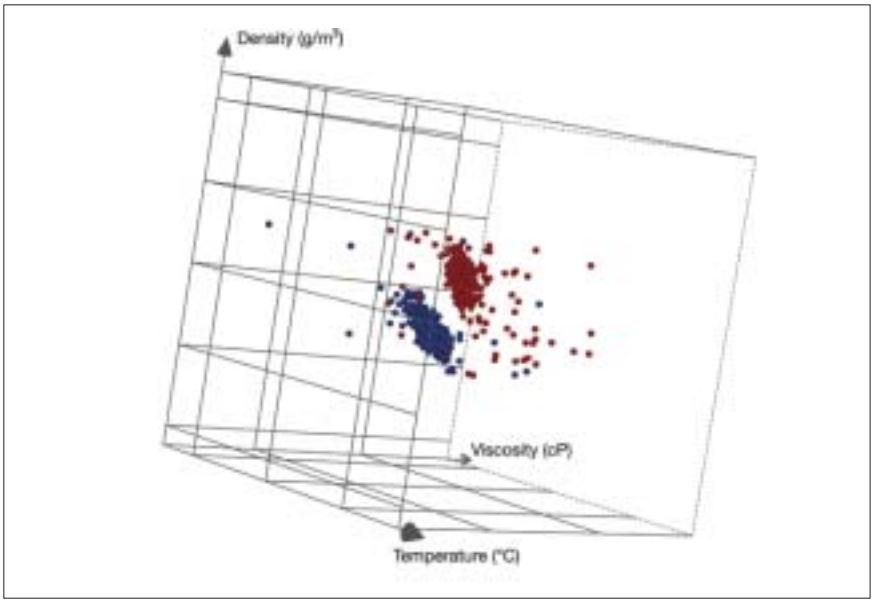
These electrical equivalent variables are varied with the aid of an FIT algorithm until a defined correlation with the measured transfer function is achieved.

This way it is possible to determine the parameters permittivity ε, viscosity η and density ρ as mutually independent variables.



Principle of the oil-condition sensor

This clear information about temperature values as well as suitable evaluation algorithms allow changes in the oil to be detected (e. g. soot or fuel entry), which was not possible with the sensors previously available on the market.



Differentiating between old (red) and refilled (blue) oil

The stimulation of the tuning fork and measurement of the transfer function takes place in an ASIC specially developed for the application. Both components are integrated in a so-called multi-chip module.

Multi-chip module tuning-fork sensor

The evaluation principle described has been patented worldwide by our project partner, the company Symys Inc., CA, and is available to Hella for exclusive use for automotive applications.

The technology chosen allows flexible and modular integration of oil-condition detection in the oil level or oil-pressure sensor. Mechanical and electrical interfaces that already exist can be retained and the design expenditure by vehicle manufacturers reduced to a minimum.

Technical data	
Voltage supply	Through higher-order unit (e. g. oil level sensor)
Temperature range	–40 °C to +160 °C
Viscosity Accuracy Resolution	1–60 mPas ±5 % F. S. 0.5 % F. S.
Density Accuracy Resolution	0.7–0.9 g/cm³ ±1 % F. S. 0.2 % F. S.
Permittivity Accuracy Resolution	1–6 ±2 % F. S. 0.5 % F. S.

Oil-pressure sensor

Oil-pressure sensors are becoming much more important in modern units as a replacement for the oil-pressure switches still widely used.

Hella's concept of bringing together the oil-pressure and oil-condition functions is designed to provide a sensor variant which will still fit in the installation space of today's pressure switch despite extended functionality.

Basically, the mapping of continual pressures in the sensor system has been established and is implemented using piezo-resistive or capacitive micro-sensors.

Within the context of combining sensors, pressure and oil-condition sensors are put together on chip level and the electrical interface designed to customer specification, using an integrated core process.

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