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FUEL DISPENSER TECHNOLOGIES

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A fuel dispenser is a machine at a filling station that is used to pump gasoline, diesel, CNG, CGH2, HCNG, LPG, LH2, ethanol fuel, biofuels like biodiesel, kerosene, or other types of fuel into vehicles. Fuel dispensers are also known as bowsers (in Australia), petrol pumps (in Commonwealth countries), or gas pumps (in North America).A modern fuel dispenser is logically divided into two main parts — an electronic "head" containing an embedded computer to control the action of the pump, drive the pump's displays, and communicate to an indoor sales system; and secondly, the mechanical section which in a 'self contained' unit has an electric motor, pumping unit, meters, pulsars and valves to physically pump and control the fuel flow. In some cases the actual pump may be sealed and immersed inside the fuel tanks on a site, in which case it is known as a submersible pump. In general submersible solutions in Europe are installed in hotter countries, where suction pumps may have problems overcoming cavitations with warm fuels or when the distance from tank to pump is longer than a suction pump can manage. In modern pumps, the major variations are in the number of hoses or grades they can dispense, the physical shape, and the addition of extra devices such as pay at the pump devices and attendant "tag" readers. Nozzles are attached to the pump via flexible hoses, allowing them to be placed into the vehicle's filling inlet. The hoses are made very tough to survive hardships such as being driven over, and are often attached using heavy duty spring or coil arrangements to provide additional strength. The nozzles are usually color coded to indicate which grade of fuel they dispense, however the color coding differs between countries or even customers. For example, a black handle is used to warn people that the fuel dispensed is diesel. In the United States, diesel fuel pumps commonly use green hoses and green slipcovers over the nozzle.

One of the most important functions for the pump is to accurately measure the amount of fuel pumped. Flow measurement is typically done by a turbine in the fuel flow. In older gas pumps, the turbine is physically coupled to reeled meters (moving wheels with numbers on the side), while newer pumps turn the turbine's movement into electrical pulses using a rotary encoder.

Most modern pumps have an auto cut-off feature that stops the flow of fuel once the tank is full. This is done by having a second tube, the sensing tube, that runs from just inside the mouth of the nozzle up to a Venturi pump in the pump handle. While the tank is being filled, air displaced from the tank is drawn up this tube. Once the fuel level reaches the mouth of the sensing tube, air is no longer drawn up the sensing line. A mechanical valve in the pump handle detects this change of pressure and closes, preventing the flow of fuel.

In some countries, pumps are able to mix two grades of fuel together before dispensing; this is referred to as blending or mixing. Typical usages are in a "mix" pump to add oil to petrol for two-stroke motorcycles, to produce an intermediate octane rating from separate high and low octane fuels, or to blend hydrogen and compressed natural gas (HCNG).

Gasoline is difficult to sell in a fair and consistent manner by volumetric units. It expands and contracts significantly as its temperature changes. A comparison of the coefficient of thermal expansion for gasoline and water indicates that gasoline changes at about 4.5 times the rate of water. In the United States, the National Institute of Standards and Technology (NIST) specifies the accuracy of the measurements in Handbook 44.

The reference temperature for gasoline volume measurement is 60 °F (16 °C). Each of the three volumes represents the same theoretical amount of energy. In one sense, ten gallons of gasoline purchased at 30° F is about 3.2% more potential energy than ten gallons purchased at 85° F. Most gasoline is stored in tanks underneath the filling station. Modern tanks are non-metallic and sealed to stop leaks. Some have double walls or other structures that provide inadvertent thermal insulation while pursuing the main goal of keeping gasoline out of the soil around the tank. The net result is that while the air temperature can easily vary between 30° F and 85° F, the gasoline in the insulated tank changes temperature much more slowly.

Temperature compensation is common at the wholesale transaction level in the United States and most other countries. At the retail consumer level, Canada has converted to automatic temperature compensation and the United States has not. Where automatic temperature compensation is used, it can add up to 0.2% of uncertainty for mechanical-based compensation and 0.1% for electronic compensation.

There are many fewer retail outlets for gasoline in the United States today than there were in 1980. Larger outlets sell gasoline rapidly, as much as 30,000 US gal (113,562 L; 24,980 imp gal) in a single day, even in remote places. The belief is that the gasoline spends so little time in the retail sales system that its temperature at the point of sale does not vary significantly from winter to summer or by region. Canada has lower overall population densities and geographically larger gasoline distribution systems, compared to the United States. Temperature compensation at the retail level improves the fairness under those conditions.

Higher energy prices have raised awareness of this issue for consumers. At the same time, alternative fuel applications are now reaching the retail market and accurate comparisons between them in normal usage are needed. Eventually the basis for retail sales will change from volume units in liters or gallons to energy units such as the BTU, joule, them, or kWh so that electricity, liquids, liquefied gases and compressed gases can all be sold and taxed uniformly.

In some regions, regular required inspections are conducted to insure the accuracy of fuel dispensers. For example, in the US state of Florida, the Florida Department of Agriculture and Consumer Services conducts regular tests of calibration and fuel quality at individual dispensers. The department also conducts random undercover inspections using specially designed vehicles that can check the accuracy of the dispensers. The department issues correction required notices to stations with pumps found to be inaccurate. Most other US states conduct similar inspections.

The technology for communicating with gas pumps from a point of sale or other controller varies widely, involving a variety of hardware (RS-485, RS-422, current loop, and others) and proprietary software protocols. Traditionally these variations gave pump manufacturers a natural tie-in for their own point-of-sale systems, since only they understood the protocols.

An effort to standardize this in the 1990s resulted in the International Forecourt Standards Forum, which has had considerable success in Europe, but has less presence elsewhere. ("Forecourt" refers to the land area on which the fuel dispensers are located.)

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