FUEL DISPENSERS

Practical hints for the verification of fuel dispensers

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Introduction

Measuring equipment for gas stations has to be verified, since firstly customers have no means of checking whether they really receive the quantity shown on the fuel dispenser indicator, and secondly gas station owners cannot control whether they receive the correct sales revenue for the quantity of fuel delivered. So both the former and the latter must be able to trust the fuel dispensers concerned to function correctly within a predefined maximum permissible error; incorrect or inaccurate functioning can lead to a significant advantage or disadvantage for either trading partner.

Testing and verification

Prior to being installed in the field, fuel dispensers should undergo a pattern approval test, i.e. every type of fuel dispenser has to be tested if both the accuracy and durability of measurements are to be guaranteed. Only after having received such a pattern approval certificate by a competent authority should the manufacturer begin batch production.

It is also reasonable to expect that new fuel dispensers first undergo in-house preliminary testing by the manufacturer - this guarantees that the units basically meet the requirements for mechanical construction and for their electronic components.

Following this, a practically-orientated initial verification is carried out at the place of installation. This is necessary because the on-site characteristics of a product such as its viscosity and its flow rates may influence the measurement results. Past experience has shown that a large number of fuel dispensers, despite having been initially verified at the manufacturers' premises, no longer operate within the maximum permissible errors when actually installed at a gas station; such fuel dispensers therefore first have to be repaired and adjusted, even though they have not yet actually been used.

Over time, the measuring qualities of fuel dispensers can change: for example a gasket in the measuring unit of a reciprocating pump can suffer from wear and tear. Therefore the instruments have to be subsequently verified and an interval of two years for this operation has proved to be appropriate. However, fuel dispensers are often adjusted or repaired before the end of the two-year period, the intention being to keep the measurement error as low as possible, i.e. close to zero. In Germany, these adjustments and repairs are carried out by assigned repair firms, who affix a repair mark to the instrument after each intervention. This mark identifies both the firm and the date of repair. However the repair, even thus certified, does not imply premature expiry of the verification validity and the repair firm or owner still has to immediately inform the verification authority which supervises the work by carrying out subsequent verifications. Afterwards the repair mark is replaced by the verification mark.

Testing equipment

This paper gives details of proven metrological equipment for the testing of fuel dispensers and tests are always performed, at least in Germany, by volume standards. The authors are not aware of any procedure which would allow on-site testing that could be performed by a gravimetric method or by using master meters or pipe provers. Since the measurement deviation of a fuel dispenser is not constant at least three tests at low, medium and high flow have to be carried out.

Classical volume measuring provers are cylindrical with a tight neck and have a scale that indicates the volume. After all the measurement procedures have been carried out, the provers have to be transported and

emptied into the storage tanks of the gas station which are most often located underground. Discharging them usually involves heavy physical work and perhaps even inhaling toxic gases. It is easy to understand that verification office inspectors have tried to improve their working conditions by transporting the provers on a cart, which is sometimes even equipped with a tipper to ease the discharge.

When working with volume standards, damage is sometimes inevitable (for example bulges which reduce the volume). But if this damage is not noticed, a fuel dispenser might appear to measure wrong, therefore other procedures have proved to be a viable alternative.

Practical testing issues

The provers are firmly mounted on a vehicle (Fig. 1) or on a small cart, which can be unloaded off the car with the help of a ramp or lifting device (Figs. 2 and 3); both these procedures protect the provers from damage. In order to conduct the tests in as rational a manner as possible it is advisable to provide a storage tank in which the test fluid can be discharged. In this way multiple consecutive tests can be performed without the need to empty the test fluid into the gas station storage tank after each individual test.

Fig. 1 Built-in testing facility in a car. While filling, the verification officer stands on the grating which is fixed to the tailboard. There is no intermediate storage of the product to be measured.

Fig. 2 Vehicle with loaded testing facility.

Fig. 3 Testing facility which can be taken out of the vehicle for filling.

One disadvantage of standards being permanently installed in a vehicle is that this vehicle has to be maneuvered onto the gas station forecourt, whereas the smaller cart (Fig. 4) has the advantage of being easily movable by hand.

The volume standards themselves do not always have to be cylindrical, they can also be rectangular - in fact they can be of any shape. The important principles are that they can be entirely filled, that they do not in-

Fig. 4 Wheeled testing facility with storage tank container underneath the provers. The pump on the left is for emptying the container if discharge by gravity is not possible (see dark hose, bottom left).

Fig. 5 Testing facility, normally mounted in a car for filling. Note the horizontally placed cylindrical provers made of stainless steel and the intermediate large storage tank lying on the ground.

clude air, that they have a scale from which the content can be read and that they can be completely emptied.

In the past provers used to be made from steel, brass or copper; nowadays they are increasingly manufactured using stainless steel (Fig. 5). A manufacturer in Ireland produces volume standards made out of a special plastic (with carbon fiber); they were featured in the July 1995 OIML Bulletin (Fig. 6). Provers of this type have been intensively tested by the Rhineland-Palatinate Verification Authority, with good results. They have an excellent volume stability even when changing temperature. Furthermore they all have a special feature: they are all provided with a vertical mounted pipe with a separation edge connected to the inside of the tight neck. When the tank has been filled up to this edge the remaining fluid to be measured is drained off automatically into this pipe with almost the same height as the prover. It is thus possible to read off exactly how much volume has been filled.

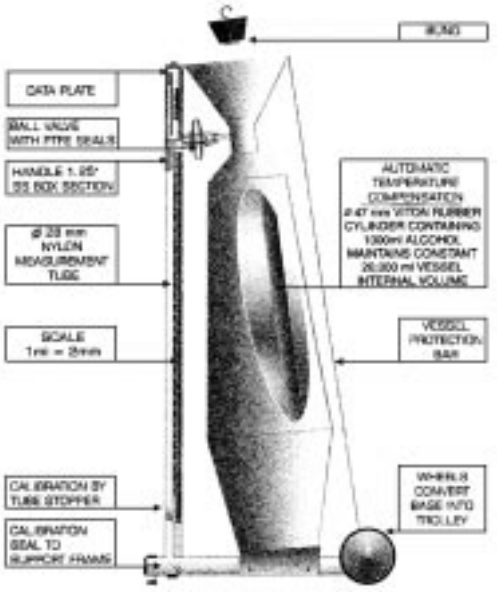

Fig. 6 Schematic description of an integrated measure.

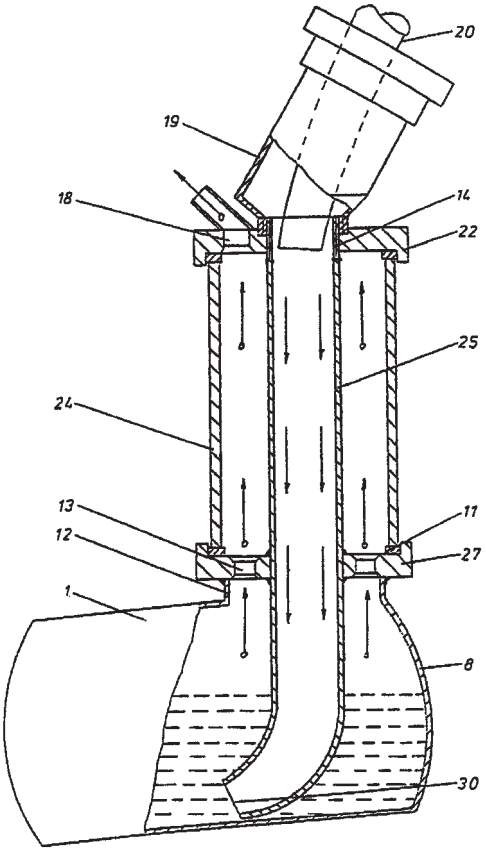

Fig. 7 Part of a patented testing facility with an outlet for the gas close to the bottom of the prover. The displaced air gas mixture escapes through openings nos. 13 and 18 in a folding receptacle (also see Fig. 8). Pipe no. 24 is made of glass, so that the filling height can be read off a scale (not on the sketch).

Another aspect should also be considered concerning the filling of provers: the fuel or diesel oil will be dumped into the provers from the top, from where air will be displaced. The air will become partially saturated with fuel and comes back out of the volume standard. Therefore, a small proportion of the filled fuel will not be measured inside the flask. Experts are in disagreement as to how much fuel evaporates in the form of gas. A quantity of 0.15 % is estimated depending on the form of the prover. This effect can be reduced by using built-in filling pipes, which are firmly affixed to the inner side of the prover, fastened to the neck and the end of the pipe is situated close to the bottom of the prover (Fig. 7). In this way the mixture of gas and air will be less than in the case when fuel "falls freely" into the prover.

Fig. 8 Testing facility with folded receptacle. When filling the prover, this receptacle collects the escaping gas and air.

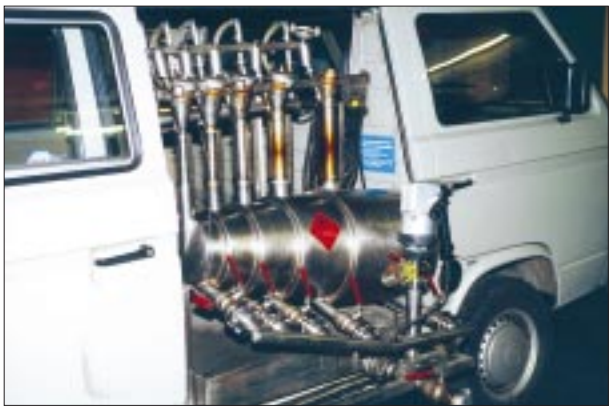

Fig. 9 Space-saving test facility.

In any case, escaping gas and air should be sucked off by hoses in order to avoid the operator breathing in this air when filling the flasks.

An inspector of the Baden-Württemberg Verification Authority has developed a patented procedure by which the escaping air does not go outside. Instead, the gas and air is collected by a plastic receptacle (Fig. 8). When the measurement has been made and the liquid medium leaves the flask, the mixture of gas and air leaving the plastic receptacle is forced back into the volume standard. Therefore, and because of the existing saturation, fresh air can be prevented from always becoming concentrated with fuel. Although this test facility saves a considerable amount of space - each test container is close to the others - it is because of the aforementioned plastic receptacle that this test facility has to be installed in the vehicle, even if it can be pulled out of the car slightly (Fig. 9).

Fuel dispenser manipulations (to the customer's disadvantage) were recently detected in one of the EU member states. It is assumed that the fuel dispensers were manipulated by remote control in such a way that (for instance) they did not deliver enough fuel to certain customers at certain times of certain days. Therefore it would be an advantage if the verification officers could control whether manipulations have occurred or not by means of a neutral test facility.

Unfortunately, in Germany the Verification Authorities' vehicles are still clearly identifiable as such, which eliminates the element of surprise and makes catching offenders very difficult.

A built-in flow meter inside the pipe close to the filler neck of a neutral passenger car could be very useful in order to highlight such manipulations.

Finally the authors wish to point out once again that even though test facilities have been in use for many decades, it has still not been ascertained:

- what percentage of the fuel mixes with the air as it escapes from the volume standard;
- whether there are other economically justifiable procedures compared to measuring using a volume standard.

In the event that any solutions or additional information to the above-mentioned points are known to readers, appropriate details would be appreciated. ■

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