Annex 5

GASOLINE DISPENSER EXAMPLE

The metrological control mechanisms for gasoline dispensers vary considerably. In some jurisdictions pattern requirements are imposed and pattern evaluation is carried out. In others, only initial and subsequent verification are used. In still others, all of these plus certain other controls are used. Controls within any one jurisdiction may be different for different types of gasoline dispensers. For example, dispensers with mechanical gearing systems for readouts and for price computation have different failure mechanisms and react differently to the environmental influences than dispensers with corresponding digital electronic systems. The control strategy for each type should therefore be appropriate to the nature of the dispenser. When total measurement error is determined with initial or subsequent verification schemes which compare the actual and the displayed quantity of dispensed gasoline, at the dispenser site, sources of error overlooked during pattern evaluation can be uncovered. The service of legal metrology should ensure that the total uncertainty of measurements made by inspectors during verifications (including uncertainties arising from volume-prover calibration, misreading of scales by the inspectors, varying environmental conditions, etc.) does not exceed a few tenths of the error limits for the dispenser. If it does, these measurements and the inspector's accept/reject decisions may be in question.

The inspectors' volume provers should be verified against higher-level standards and carefully recalibrated whenever damage is suspected. The uncertainty in calibrating the provers should be quantified. Experiments involving redundancy and randomization should occasionally be carried out to assess verification accuracy and the impact of seasonal variations. An example is an experiment in which several inspectors retest the same dispensers, each using a randomly selected prover, from a group of nominally identical provers, at randomly selected times. The scatter in results provides an indication of the consistency of the measurements made by the inspectors. (For such checks one requires the actual dispenser and prover readings, not only records of whether the dispensers were in or out of compliance). The following example, though hypothetical, is based on actual experience in one of the States in the United States and illustrates assurance of control for gasoline dispensers, with design requirements and initial and subsequent verification the only control techniques used. The error limits are established by law, and verification officers periodically verify each dispenser in the State. Compliance data should be plotted on a control chart. As long as the inspectors' data indicate compliance in excess of the target compliance, let us assume 95 percent, the controls are considered to be adequate. If compliance drops below 95 percent and cannot be restored quickly, then more frequent subsequent verifications and the addition and/or substitution of other control elements should be considered. However, before changing the controls, the reasons for the poor compliance should be sought. (The use of dispensers is, of course, prohibited until they are repaired and shown to comply again). Such collection of data in the field and their subsequent processing is now very much facilitated by various portable computers (PDAs etc.) with customized software used in the field to transfer data e.g. over telecommunication networks back to a hub server (if the use of radiotelephones is permitted on spot). This system is viable under assumption that the gathering of data in this way is not obstructed by activities of servicing organizations.

Gasoline dispensers with errors which exceed maximum permissible errors only slightly, may be considered to be in a different category from dispensers with large errors. Because the severity of the consequent official actions may be influenced by the magnitude of such excess errors, it is advisable to maintain histograms of the error distributions. There was a case in the USA in which metrological control had been achieved, that is, in which compliance exceeded the objective, from January to April. However, from May to June the compliance level is seen to have dropped. When such a situation occurred in the jurisdiction from which this example is drawn, control could be restored rather quickly because excellent field verification data records had been kept of make, model, and serial number of each dispenser, inspector and date, volume prover used, and other pertinent facts. These data were stored in a computer so that possible correlations could be investigated to determine whether compliance was low in only a part of the jurisdiction or there was any correlation with such factors as: the verification officer, the prover used, the manufacturer of the dispenser or the individual or firm servicing it, the company owning the gasoline stations, etc.

Results in this case showed only the one correlation that compliance had deteriorated for one make and model of dispenser, but only for a particular range of serial numbers. Officials were able to resolve this problem quickly. The manufacturer of the non-complying dispensers was known to be reputable and when approached by officials, cooperated in resolving the problem. It was found that the offending dispensers had been manufactured when a key component was unavailable from a regular supplier and that an alternative source of supply was used temporarily. It was hypothesized that performance had been degraded because the reliability of the substituted part, though manufactured from nominally equivalent materials, was lower than that of the original component. With official concurrence, the manufacturer replaced the questionable components and the dispensers returned to their previous, high compliance level. Several points are worth noting in the above case: legal metrology officials had a quantified and well documented compliance objective. While they chose to rely on subsequent field verification, rather than on (initial) verification at the factory or on pattern evaluation, enough data were gathered to permit determination of the probable cause of unacceptable compliance. Whether pattern evaluation and strict enforcement of adherence to the pattern might have prevented this problem is unclear. Because the manufacturer had no reason to believe that the alternative source of supply would result in lower reliability, officials would probably not have been notified of the alternative source of supply even if the device had originally been pattern approved. Thus, one sees that, where device manufacturers are responsive and cooperative, control by only subsequent verification and control charts can be effective without prior pattern evaluation. Where device manufacturers are less concerned with the accuracy of their products than the manufacturer in this example, pattern evaluation may be a cost-effective supplement to field verification.

Demonstration of gasoline dispenser compliance with regulations is usually sufficient to ensure marketplace equity. However, unscrupulous vendors can find innovative ways to use an accurate dispenser to defraud customers, for example, by purposely failing to disengage the motor and pump after a delivery. In such cases, it is possible to begin another delivery at other than zero and to be paid twice for the same product. Another modern sophisticated method of so called “soft” frauds is described in Annex 7. Even where such practices are not common, legal metrology officials cannot ignore this possibility. Vendors suspected of such practices can be kept under surveillance and/or special, unmarked vehicles, equipped with calibrated tanks, can be used. This is not to suggest that officials should emphasize such enforcement activities, but rather to make the point that instrument verification alone does not always ensure equity in the marketplace.