MARKET SURVEILLANCE

Using diagnostics in market surveillance

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Abstract

A growing number of measuring instruments are fitted with features that monitor the instrument's health. In oil and gas metering, these so-called diagnostics can be found in almost all new Coriolis mass flow meters, ultrasonic flow meters, gas chromatographs, etc. With the exception of some, the majority of the diagnostic functions have no direct link with legal metrology. However, their use in legal metrology could be worth considering.

Introduction

Measuring instruments come in many shapes and sizes and so do the companies supplying them, but diagnostics being added to instruments, is an unstoppable trend. The main reason for this trend is that there is value in this type of information. While this requires some extra insight in the operation of the instrument and its diagnostics, there is something to be learned from it. To name only a few advantages, a user of measuring instruments can use diagnostics to look deeper into his process and a supplier can perform troubleshooting more easily than in the past. At the last edition of the European Flow Measurement Workshop, end users raised the question whether these diagnostics could impact calibration intervals. And since this information is available, why not including diagnostics in market surveillance?

It is all about confidence

Legal metrology is about confidence. The purpose of testing and certification is to provide confidence in measurement to all parties involved. The extent of confidence is related to measurement accuracy – or maximum permissible errors – but also concerns data integrity. All parties involved want to know whether the instrument is performing within legal tolerances and if the presented measurement information is compromised or not. These questions apply not only during assessment of such instruments during type approval and initial verification, but over the entire lifetime of the instrument. Diagnostics features are typically active continuously, or intermittently, whenever the instrument is switched ON, offering a continuous check on the performance of the metering system.

Below, potential uses of diagnostics information in market surveillance will be presented. The main purpose of the presentation is twofold: to create awareness and to open up the discussion for possible future follow-up.

Introduction to diagnostics

Looking at OIML Recommendations, a familiar term is "checking facilities". For electronics, one example of such checking facility is a watchdog arrangement. This arrangement checks the electronics' health, which is why a technology oriented person would probably categorise it under diagnostics. Watchdogs perform fairly general checks, but some diagnostics perform very specific ones. One might only perform checks on a certain voltage, or a signal to noise ratio. Others perform checks that are more related to the measurement process itself.

In multi-path ultrasonic flow meters for instance, the shape of the flow profile can be checked. When it comes to measurement accuracy, ideally the flow profile is symmetrical and hardly changes over time. Conversely, if it does change (suddenly) it could indicate that the upstream conditions have changed. A possible reason for this could be that something got caught in the upstream flow conditioner. No matter what the exact reason is, it is cause for concern, since measurement accuracy might be compromised.

The operation of Coriolis mass flow meters relies on the vibrational properties of the measurement tube(s). If, for some reason, the measurement tubes become corroded or eroded, the vibrational properties will change. Consequently, also the measurement characteristics of that meter will change.

Diagnostics and market surveillance

What can the value of diagnostics information be in legal metrology? In the examples given above, clearly measurement accuracy might be affected. However,

what if nothing has changed? This too can be valuable information, especially when considering that we are all striving for measurements to be reliable.

A common way to sub-divide market surveillance on a measuring instrument is:

- conformity check;
- functional check;
- pass/fail decision.

The conformity check starts by checking the integrity of (mechanical) seals. If these are in proper order, spot checks may be performed on other items, but generally speaking, one would then assume the instrument to be in conformity to type and "touched" only by those allowed to do so. Although slightly depending on a nation's policy, the main portion of the functional check usually is re-calibrating the instrument, or performing a calibration to check that the instrument is still operating within legal requirements. Lastly, if all is well, the inspection officer will decide to allow the instrument to be used for another (predetermined) period of time.

Performing (re-)calibrations on instruments in the field can be challenging. Particularly when looking at the oil and gas industry, options are not only limited, but also complicated. At this moment in time, high-pressure natural gas measurement is a field where on-site calibrations are complex processes and require going off-line. For some industrial liquid metering applications, mobile provers can be applied, but easy is never the first word that comes to mind. In some cases therefore, meters are sent to calibration laboratories and re-installed into their applications upon return.

Happily skipping the debate on which approach is more or less perfect, here is where diagnostics might be considered in legal metrology. Let us assume for starters that "our" market surveillance officer is perfectly knowledgeable about the instrument, its diagnostics and the process it is running in. Let us also assume that the diagnostics too are perfect, meaning they cover any eventuality and are functioning correctly. If that idealised picture is true and the diagnostics say all is well, performing a (re-)calibration would not be necessary in order to obtain confidence in the measurement.

Without becoming too philosophical, 100 % perfection does not exist. However, by nature legal metrology is not about 100 % confidence either. One example of the latter is the well-accepted statistical verification of large numbers of instruments in the utility world. Here, there is always a small chance of under-performing individuals slipping through the mazes of the regime. That said, the question arises of confidence levels in relation to diagnostics. Let us make a few more assumptions before continuing:

- not every market surveillance officer shares the same level of knowhow;
- not every instrument is fitted with top quality diagnostics;
- it is impossible to predict, and therefore diagnose, all events that might occur in the field;
- because of the previous, it is impossible to test for all field eventualities.

Especially in relation to the last bullet above, note that OIML Recommendations have a philosophy on checking facilities to prevent the need for infinite testing. Having suitable and well-functioning checking facilities offers enough confidence to reduce the number of tests to a finite and manageable number.

Confidence in diagnostics

So far, we have mentioned Coriolis mass flow meters and ultrasonic flow meters. Taking a broader perspective one could say these are both flow meters. However, when taking a closer look one can also say that one Coriolis meter is not the same as another. The point of these statements is that it takes insight to determine which diagnostic information offers added value and which does not.

During the type approval process, test engineers learn quite a lot about the instrument they are assessing. Most notably they learn the factors the instrument is sensitive and/or insensitive to. Because diagnostic features on high sensitivity factors have a high added value, a test engineer should be able to determine – in a, for now, subjective manner – how well that particular diagnostic feature can provide additional confidence in instrument performance.

In short, the above line of thought is reason for suggesting that diagnostic features tested in conjunction with type approval could be used at other stages in the legal metrology regime, including market surveillance.

Coming back to the example where the flow profile, as "seen" by the ultrasonic flow meter suddenly changed due to a partial blockage of the upstream flow conditioner, being able to detect changes (instead of just absolute values) significantly adds to the value of diagnostics. Detecting changes requires at least one of two things: either logging relevant parameters over time, or (automatically) detecting changes. One could even foresee a future where such activities occur remotely. Imagine measuring instruments being connected to the internet, enabling users, suppliers and legal metrology authorities to read values from the instrument. Ultimately, this could allow remote market surveillance.

The previous paragraph may have a high "crystal ball" content, but that too would enlarge the confidence

in diagnostics. After all, market surveillance authorities would then have access to the instrument and its diagnostics any time they desire.

Foreseeable challenges

Suppliers of measuring instruments will always attempt, and rightfully so, to differentiate their product from that of their competitors. When it comes to diagnostics, some will therefore decide to either offer as many features as they possibly can, or – at the other end of the scale – as little as possible, in order to save cost. In other cases suppliers will apply diagnostics to the parameters they consider important. Ultimately, this will result in a sheer endless range of variations in the diagnostic features on offer. Moreover, this will change over time at a rate of change possible in any particular measurement technology. This makes it almost impossible for all those involved in legal metrology to keep up with. At the same time, it would not make sense to completely ignore the benefits that this technology could bring. It would therefore make sense to start thinking about listing, for each measurement principle, the diagnostic features we would like to see incorporated in measuring instruments. Naturally, these should be those that provide a high level of added value, in other words, those that have a major impact on the operation of this type of instrument. The challenge does not stop at agreeing on which diagnostics features are crucial, as opinions will likely diverge. We should also consider the level of testing needed to provide adequate levels of confidence.

It is not without reason that multiple parties have been mentioned: users, suppliers and legal metrology authorities (both type approval and market surveillance). Each of these parties has specific knowhow that can contribute to the future use and value of diagnostics. Conversely, this also means there is role for (representatives of) each of those in the discussions on diagnostics and their use. The differences of interest of the various parties involved will obviously have an impact on reaching unanimity.

Suggestions for the future

The main point of this article is for all stakeholders to start thinking about the use of diagnostics, if they have not already started to do so. The reason for this is that there is something to be gained for all those involved. The user potentially has better information and fewer on-site disruptions. The supplier has a product that better fits his client's needs. Metrology authorities have more and easier ways to provide confidence in measurements.

At the upcoming European Flow Measurement Workshop, to be held from 16 to 19 April 2018 in Barcelona, this topic will be addressed and discussions will be started on how to perform tests on diagnostics, and which ones. The umbrella of confidence in measurement benefits society as a whole. ■