ANALYSIS AND DISCUSSION ON R50-1 3CD-2010

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Abstract: This paper describes the differences of R50-1 between the 3CD-2010 version and 1997E version. Gives the analysis on disagreement contents in the new version, and then talks about the influence of the new version to the manufactures and the Institutes in the future.

Keywords: R50, AWI, belt weighers

1. INTRODUCTION

The R50, version of 2010, was discussed in London on 4.18-19.2011. Compared with the old version of 1997E, there're great changes in the new version. The main points are: introducing 0.2 class-a higher accuracy，durability，EMC，software requirements and concept of family. These changes have been first described in R50-1 2009. A few people really understand the existing disagreement problems of the new version, but they don't realize the forthcoming influence to the belt weighing instruments (BWI) manufactures and the Institutes which are carrying the tests and experiments of Type Approval.

2. MAIN CHANGES AND DIFFERENCES

Some terms which listed in the old version of R50 were deleted and some new terms and definitions were added in the new one. Such as: control method, metrological relevant, legally relevant, audit trail, belt profile correction device, module, software, data storage device, interface, maximum load per unit length of the belt, type, family and so on. The following showed some new key terms and definitions:

1. Terms and Definitions
   1) Module

Typical modules of an automatic weighing instrument (AWI) are: load cell, indicator, analogue or digital processors, weighing unit, remote display, software. You can find figure 1 in R50-3CD, "Load cell" module means not only the force transducer itself, but also the combination of load cell, displacement transducer and data processing (optionally).

   2) Software

Software is a general term, which has been first described in R76. In R50, the term includes Software identification, Software separation, Legally relevant software and Legally relevant parameter. The Legally relevant parameter includes Type-specific parameter and Device-specific parameter. Usually, the software in measuring instruments can't be divided into two parts. In this case, the whole software has to be considered as legally relevant part.
(the 4CD says all software modules are legally relevant)

   3) Data storage device

It's applied for later legally relevant purposes, especially in the case of a commercial transaction. Keeping information of measurement data for a long period is the main function.

   5) Interface

Usually, the interface plays a role of filter which only allows the introduction into the instrument of data and those instructions cannot influence the metrological properties of the instrument. If the interface is used to interchange information between an operator and the measuring instrument, it is called user interface.

2. Metrological and technology requirements
   1）Accuracy class

The class 0.2 has been introduced into R50. Some people have different views on the new higher accuracy class. In fact, it is very difficult to obtain such accuracy because the requirements on zero stability are very high. However, also for the reasons of installation process quality, severe mechanical and environmental conditions, higher accuracy classes are not to be allowed.

   2）Minimum test load

Minimum test load is one of the new added requirements used at in-situ test. This requirement was changed again in the 4CD of R50.

   3）Durability

Durability is one of important added requirements. There're two steps for durability test as follow. Measures to ensure durability may be taken subject to national regulations.

      1) in-situ product test (the 'initial test')
      2) in-situ product test (the 'final' test)

   4）Out-of-range and operation warning indication or checking device

More detailed description of this device was added in R50-4CD. And an indication is intended as a warning indication and its operation shall be obvious, for example, an obvious continuously beeping would be an acceptable solution. The use of different indications for each cause is acceptable.

   5）Securing and sealing of components and pre-set controls

This is another requirement on security of operation as above. Components, interfaces and pre-set controls that are

not intended to be adjusted or removed by the user shall be fitted with a securing means or shall be enclosed. Adequate securing shall be provided on all parts of the measuring system which cannot be materially protected in any other way against operations liable to affect the measurement accuracy.

6）Belt Profile Correction Device

This device should be permanently in operation, or permanently disabled. And it may be combined with an automatic or semi-automatic zero-setting device or not.

7）Minimum scale interval of the used load cell(s)

When analogue strain gauge load cells are used, the minimum scale interval (Vmin) of the load cell shall fulfil the following equation:

$$Max \geq S \times vmin \times R / \sqrt{N}$$

Where, S = 15000 for class 0.2
   S = 6000 for class 0.5
   S = 3000 for class 1
   S = 1500 for class 2
 R is the reduction ratio of the load receptor
 N is the number of load cells

When digital load cells are used, the above formula shall also be used. But due to pi (fraction of the MPE applicable to a module of the instrument which is examined separately), the following S values shall be used in the equation:
   S = 10000 for class 0.2
   S = 4000 for class 0.5
   S = 2000 for class 1
   S = 1000 for class 2

8）Disturbances

There is a shortcoming in R 50:1997 with a view to guidance on disturbances and their intensity. In China and Europe until now ，there is an intensified discussion on what the disturbance threshold of WI should be and whether the aspect of fraud using by the means of electromagnetic sources affecting the weighing instruments should be taken into account. Although not a result for this discussion, the requirements of EMC become more severe. The main requirements of disturbances are:

- AC mains short time power reductions;
- Electrical bursts (fast transient tests) on mains voltage lines and on I/O signal and communication lines;
- Electrical surges on mains voltage lines and on signal and communication lines;
- Electrostatic discharge test;
- Immunity to electromagnetic fields;
- Immunity to conducted electromagnetic fields.

3. ANALYSIS AND DISCUSSION ON DISAGREEMENT CONTENTS

There are some controversy contents existing in the OIML International Recommendation. Some requirements bring puzzles to us including the manufactures and Institutes. Here are some problems debated in China.

Disagreement Items:

1. Scale intervals

In R50, There is no requirement to the value of scale interval. That means it's nothing between the accuracy and the scale intervals. Theoretically, the value of d was unconstrained. Actually, it's not the larger the better. If the value of d was larger, the Minimum totalized load should be too large. It would take more cost and not easy to pass the discrimination experiment.

2. Control value

What's the role of this value? There is no explaining of control value in 3CD. From the definition, control value is a simulated value which got from the simulation tests. But the problem is how large the error of control value is? If the value exceeded, we need a product test again? In R50, there is no explanation about of this. Actually, it's difficult to provide the value.

3. Simulation tests

For the displacement simulating device, its better to use the motor of variable frequency speed control. You can not test the speed sensor if only using a pulse signal generator. A pulse counter is needed if belt weighing instrument doesn't have a function of pulse number presetting.

4. stability of range

Stability of zero has been described in R50, but stability of range has been written in R76、R51、R61、R107 and R106. In according to R76, the test of stability may be carried out during the simulation test in the type approval period. The shorter one of 28 days or the time for the performance test required may be chosen as the test time of stability. The static load near Max may be chosen as test load.

5. Minimum flowrate (Qmin)

The minimum flowrate of single-speed belt WI shall be equal to 20 % of the maximum flowrate. Sometime, the minimum flowrate shall not exceed 35 % of the maximum flowrate. With the development of belt WI technology, its worth talking about the rule of 20% is reasonable or not. This parameter should be specified by the manufacture.

6. Family

There's only the concept but no explanation in the CD. It brings puzzle to people who sampling the EUTs. Fortunately, the content of family is written detail in R76 and the 4CD of R50. This concept primarily aims at reducing the test effort at type examination. "Family" has 3 essentials: same manufacture, same type, different performance. First, neither weighing instruments nor modules belong to the same manufacture. Then, the modules or weighing instruments have the same design features and metrological principles for measurement. For example, the type of indicator is same. Last, these modules or instruments may differ in some metrological and technical performance characteristics such as Max, Min, d, accuracy class, and so on.

7. EMC

In R50-3CD, the test on sensitivity to radiated electromagnetic fields has been adapted to R76 and IEC 61000-4-3. This means testing at frequencies up to 2000 MHz at field strength of 10 V/m. It will bring great influence to the manufactures and institutes in the coming days. More experiments will be done for testing the EMC of modules belt WI. And more expensive laboratory instruments will be bought and installed for the more severe provisions of EMC.

8. software

The program about measuring and totalization indicating is considered as a core part of the belt weighers. Securing legally relevant software against fraud using and modifying parameters after verification becomes a worldwide problem. In 3CD, software is addressed in a dedicated chapter. Security of software is so important due to the fact the measurement on the belt weighers is normally not repeatable. In 2010, Experts and technicians discussed the issue that the WI was fraud used with software backdoor or hiding software functions at a special workshop in Bangkok. A consensus was the software shall be identifiable and secured against fraud using or modification without authority after verifying and sealing the instrument.

9. durability

However, lots of facts and experience in most countries including China have shown that the belt weighers lose their original metrological properties after a period of using. Unfortunately, the period is shorter than the period of cycle verification. That means over a long time the belt weighers don't fulfil the necessary requirements of accuracy class. Considering the large amount of material and money, an acceptable method should be founded and be used.

These disagreement issues are not only discussed in manufactures but also in technology Institutes.

One of the important issues is the introduction of the new higher accuracy class 0.2 and carrying out examination of TA in a special laboratory with field strength of 10 V/m.

Even more important is that how a belt does keep its metrological properties over a longer time. That means there should be a new method to do "durability test". In R50, the test might be performed under laboratory conditions or in-situ. The advantage of in-situ test is genuine strains of normal using a belt weigher. While in laboratory, fixed simulation conditions and equipments are installed that can act on the belt weigher by a variety of strains, such as vibration, dust and others. Costly equipments are required when performing durability test in laboratory.

During the meeting of OIML TC9/SC2 R50-3CD, April 2011 in London, some experts said: Chinese engineers bring us a new solution to settle the durability test problem. In China, the metrology institute of Jiangsu province is building a special laboratory which shall be the first and largest laboratory of AWI in the world. Whatever the complete set or modules of AWI can be examined in the laboratory. What the manufactures only worry about is how to pass the more severe examination and get the certificate of TA. The manufactures which have better research and development capabilities will get more certificates and market share than those have lack capabilities of innovation.

4. CONCLUSIONS

R50-3CD contains the latest developments in the field of software just like R76, and the higher accuracy class of 0.2 will probably open up the way to new areas of use of belt weighers. Now the 4CD is asking some countries for advice all over the world. The final version of R50 would bring a great challenge to the Institutes for testing the durability of belt weighers. And also a great challenge to manufactures is the more severe EMC requirements and 0.2

higher accuracy class. Some controversy contents will be checked during the practices of TA.

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