Proposal: OIML R50-1 Selection of EUTs

It is a significant cost to a manufacturer to acquire a type approval for a legal-use weighing device. A possible approach to mitigate these costs would be to submit a sample device that is representative of a certain type or pattern produced by a single manufacturer. The evaluation of this representative device could then be used to issue a certificate for the entire group based on common operating, metrological, and design principles.

The practice of manufacturers to produce devices which target the specific needs of their users creates a situation where it is necessary to produce a variety of devices, each designed to fulfill the special needs of individual applications. Within the manufacturing process, devices may be designed that are similar in regard to significant properties, and vary only in aspects related to the characteristics of their size, capacity, material measured, rate of flow, etc. This method of production allows the manufacturer to supply many customers with devices using the same fundamental design and thereby reducing the cost of retooling necessary when producing variations of that same design. Although some features will differ, similar devices may be manufactured based on and incorporating the same principles involving operating controls, metrological blueprint, and basic architecture.

This concept is currently incorporated within OIML R50 and is addressed in several clauses. Clause 5.1.6.1 provides some direction for selecting the representative instrument to be tested (EUT) however those guidelines are vague and may lead to inconsistencies between evaluation procedures. This issue was considered during a meeting of OIML TC9/SC2 members that was held on April 18-19, 2011 at NMO in Teddington, UK. The participants of that meeting discussed the criteria for the selection of EUTs under the "family" of devices approach, and concluded that more specific guidance is needed for those performing type evaluations of belt weighers with regard to selecting a model that is representative of the family. There were no conclusive verdicts regarding the matter during this meeting however, a work group was formed and asked to develop a proposal that will bring this matter to some resolution. The following comprises the concerted efforts of that working group.

The selection of EUTs for type approval examinations.

The selection of EUTs must begin with detailed communication between the manufacturer and the evaluator. Details regarding the models that the manufacturer intends to be included within a family must be provided by the manufacturer so that the selection of a representative device will include a focus on specific details unique to that product family. This practice will serve to streamline the type approval process and reduce time and cost of the evaluation process.

OIML R50 currently requires that documentation be supplied by the manufacturer with an application for type evaluation (clause 5.1.1) that includes details particular to that "type". In addition R50, clause 5.1.2 requires that at least one unit be completely installed at a typical site and at least one unit be submitted that is suitable for simulated performance evaluations in a laboratory setting.

As noted in R50, clause 5.1.6 the manufacturer may provide a definition for a family of devices based on similarities among the models to be included within the family. This definition is subject to agreement with the metrological authority that will ultimately be responsible for the selection of the EUT.

This determination should be based on a number of aspects that describe the device(s) beginning with the fundamental engineering design. The structural design must be consistent throughout all models within the family although optional configurations and features may be permitted.

Examples of the principal designs currently found in service are (but not limited to) multiple idler-modular type; weigh platform/frame with variable number of idlers and the multiple idler pivoted weigh frame. Within each identifiable "type" there may be models that vary in size, capacity, and application however; all models categorized within a family should function using the same basic engineering design.

Classification of engineering designs should also include consideration based on the technology incorporated within the weighing element used. Classification of devices within families based on these criteria may include but not be limited to the following categories:

1. Mechanical – lever system based weighing elements;
2. Analog, strain gauge load cells;
3. Digital load cells.

In addition, those devices using a form of load cell technology may also be segregated into families using the method by which load cells are mounted to the weighing elements and the supporting structures. Examples are:

1. Direct mounting on Load Cell without check rods;
2. Connection of the weighing elements to load cell via lever system;
3. Isolated from load cell and with check rods or flexures.

Another criterion related to engineering design that may be used to determine whether a device is to be included within a family would be the number and the configuration of idlers used in the design. Some examples follow:

1. Multiple idler, fully-suspended;
2. Multiple Idler, modular;
3. Multi-Idler, approach/retreat weigh frame with lever connected to single load cell.

Modular approach

Another approach for the evaluation of belt weighers to be considered within the type approval process would be to consider and evaluate certain components within the system apart from that system. This notion is contained in the current draft of OIML R50 in clause 5.1.6. where it is stated that modules may be evaluated as separate units. Various modules such as load sensors, indicators, and data storage modules may be included in various belt weighers or alternate versions of these modules may be offered as options that are available in a particular pattern of belt weigher.

This approach may be useful when evaluating certain components intended for use with a number of various belt weigher systems. One such component is the belt displacement transducer. The transducer's design and the method used to link it to the conveyor system may be used as a basis for classifying the transducer as belonging to one family or another. Supplemental to the transducer's design and the method by which it is associated with the conveyor, is the consideration of the transducer's output frequency as a means to place it within a family of related instruments.

This modular approach may be used to efficiently evaluate components of the belt weigher system in a controlled environment. This method of evaluation would not replace the need for an in-situ evaluation of the entire belt weigher which is dependent upon the performance of these components operating within the system and in combination with the conveyor belt.

Worst case representative instruments

In the interest of reducing the amount of testing needed for type approval of a family of devices, the "worst case" representative of that family may offer the best choice as a selection for the EUT. Successful test results from the evaluation of a worst case model may be used to infer acceptable performance for a device that is equipped with optimum features and which is perhaps better suited for a specific application. Making the selection of the worst case device is complicated however, by the fact that a single model within a family may not represent the worst case with regard to every aspect of operation or performance. The worst case example for one specific application may not be the worst case example for another application. It is therefore suggested that when practical, devices representing a range of specific criteria rather than one extreme be evaluated to fully establish test data over the spectrum of available instruments which may be categorized within a family of devices.

This proposal recommends the use of the following factors which may aid in determining a device's suitability for various circumstances. Samples representing worst case instruments may be selected as the EUT to be submitted based on the following criteria:

1. For testing that is performed in a laboratory setting, the selection for worst case instruments will be the device with the:
    a. Lowest input signal from the force transducer(s);
        i. Smallest input signal from the force transducer for the measuring range / measuring range in kg ratio (gives a mV/kg sensitivity);

ii. Lowest input signal from the force transducer for the dead load;

b. Unit with the maximum number of interfaces;

c. Highest frequency of belt displacement transducer;

d. Highest or best accuracy class;

e. Minimum input impedance (i.e., maximum number of load cells) (this example could also be performed as part of In-situ test);

f. Variable speed beltweigher. If this option is not applicable, then select the multi-speed beltweigher. If this option is not applicable, then use a single speed beltweigher.

2. For in-situ testing, the selection for worst case instruments will be the device with the:

a. The fewest number of weigh idlers in the family;

b. Variable speed beltweigher. If this option is not applicable, then select the multi-speed beltweigher. If this option is not applicable, then use a single speed beltweigher.

In addition to the selection of the worst case sample as a EUT, there are other factors already listed in R50 (3CD) under clauses 5.1.6.3 and 5.1.6.4. which are not repeated within this proposal. These factors however must also be included in determining an acceptable and representative sample.

As stated earlier, the selection of EUTs must be based primarily on information provided by the manufacturer and taken into consideration by the evaluator. This information must be used to provide a familiarity of the design of the device and the commonalities shared within all models to be included in a family grouping. This familiarity is necessary for the evaluator to determine the proper placement of an individual model into a family grouping with other models.

Other considerations:

Number of idlers

It was not the intent of this working group to broaden the scope of the stated purpose of this proposal (i.e. “the selection of EUTs”) by focusing on other proposals related to the revision of R50. It has been recognized however, that at least in one aspect, this issue is interwoven with another proposal that pertains to durability testing and is now under consideration by TC9/SC2.

During the deliberations regarding the number of idlers used as a basis for determining a worst case situation to be considered for an EUT, it was acknowledged that in general, the system using the fewest number of idlers would represent a worst case sample. It is recommended that the manufacturer be allowed to determine the optimum equipment for each particular installation, including the number of idlers needed. However, if the manufacturer wishes to install a legal-use beltweigher that incorporates

fewer idlers than has been approved in an existing type approved system, either an amendment must be performed to the existing certificate or a new certificate must be issued.

It is also recognized that any evaluation of a system with regard to the fewest number of idlers used would need to be performed in-situ to determine the effects that a variation in the number of idlers will impart on the belt carcass (belt sag, tension, flow rate, etc.). A reduction in the number of idlers will most likely result in greater challenges to overcome the effects imparted by the change in the dynamics of the belt conveyor.

Furthermore, the major concern involved with systems using a relatively small number of idlers is the stability of the system's performance over a period of use. This proposal will therefore recommend that a certificate representing the successful type approval evaluation be issued based on ***both*** an ***initial***, in-situ test of a beltweigher using a minimum number of idlers ***and, a subsequent (durability)*** test performed to assess the systems stability after a period of use. It is also recommended that national regulation determine the legal status of the EUT during the interim period between initial and subsequent, durability tests.

Practical considerations:

There are other, more practical aspects that must also be considered by the metrological authority outside of the design characteristics when making a decision on the type evaluation procedure for any given beltweigher submitted. These considerations must be part of the decision making process, although they should not be allowed to detract from the validity of the evaluation. It is recommended that the guidelines included in this proposal be followed, provided this can be accomplished without the need to apply unrealistic or unreasonable demands on the applicant or to measures regarding test equipment and facilities. This type of consideration may include but should not be limited to:

- Which beltweigher can be evaluated without unreasonable demands on the test facility?
    - For field evaluations: access to the device for testing purposes must be secured so that testing may be performed when necessary.
    - For laboratory evaluations: the beltweigher cannot be of a size that is larger than the space available.

- Which beltweigher model(s) within a family is expected to be most popular and more prevalent in the marketplace?

- Which beltweigher model(s) within a family does the manufacturer currently have available to offer for testing at which time tests may be scheduled?

- What is the range of capacities in a proposed family?

In summary:

- Communication between the metrological authority and the manufacturer of a belt weigher submitted for type evaluation must be complete with details regarding the design and capabilities of the instrument. The manufacturer may define the criteria that will be used to classify models within a family, although this definition is subject to the agreement of the metrological authority. Documentation from the manufacturer must be made available to provide the evaluator with enough detail so that an educated decision is possible in the determination of what models are to be included under the same approval certificate.

- Modules that are incorporated within a complete system may undergo type evaluation apart from the beltweigher they are associated with. Influence tests which are targeted to assess the effect of influences on particular components may be performed on the modules themselves in controlled environments. In certain instances, it may be determined to be more efficient to perform evaluation of modules via simulator interfaces during the assessment of their performance in laboratory conditions. This may help reduce the amount of testing necessary during the evaluation of the system the modules are used in. The approval of these individual modules however should not convey a blanket approval to the complete beltweigher system in which they will be incorporated.

- It is recommended that beltweighers be categorized primarily by the fundamental engineering design they are constructed upon. The categories of design may include but are not limited to the following basic operating principles:
    - Mechanical – no electronics;
    - Analog, strain gauge type load cells;
    - Digital load cells.

- Those beltweighers using load cell technology may further be categorized by using the method that the load cells are mounted/connected to the weight receiving element and supporting structures. Examples may include but are not limited to:
    - Direct mounting of Load Cells without check rods;
    - Connection of the weighing elements to load cell via lever system;
    - Isolated from load cell and with check rods or flexures.

- An additional method of classifying beltweighers within a family can be based on the number and configuration of idlers used within the weighing element. Examples may include but are not limited to:
    - Multiple idler, fully-suspended;
    - Multiple Idler, modular;
    - Multi Idler, approach/retreat weigh frame with lever connected to single load cell

- In order to streamline type evaluation test procedures involving a family of devices, it is often desirable to select an EUT that represents the “worst case” sample from that family. This proposal will recommend that not only the worst case be selected but also that an instrument representing a best (or better) case be evaluated to establish a range of performance data within the family of devices. For beltweighers, it is recommended that the worst case instrument be selected based on the following:

- For testing performed in a laboratory setting:
  - Lowest input signal from the force transducer(s) (see 5.1.6.5);
  - Unit with the maximum number of interfaces (i.e. peripheral equipment, hardware components);
  - Unit with the maximum number of load cells;
  - Unit with the highest frequency of belt displacement transducer output.

- For in-situ testing:
  - The fewest number of weigh idlers in the family.

- When evaluating a system using the fewest number of idlers as a basis, it is recommended that after an initial in-situ test is performed, a subsequent, durability test be performed to establish that the reduction of the number of idlers has not resulted in an unsatisfactory diminished ability of the beltweigher to perform as intended over a period of time and use.

Additional consideration:

This work group recognizes that the major portion of this proposal does not offer specific, itemized criteria to be used for the classification of EUTs. Instead, the proposal promotes a more generalized approach in the process for making the selection of EUTs that is believed to provide latitude for both the testing authority and the manufacturer of the device. This draft proposal will therefore ask for the consideration and input of TC9/SC2 members and the Secretariat to determine the proper method to incorporate this proposal within R50. One suggestion would be to incorporate the content of this proposal as an annex within R50 similar to the annex for the selection of EUTs included in the current edition (2000) OIML R60.