PROFICIENCY TESTING PROGRAMME AQUS-TUBE_IMPEDANCE_2

1. INTRODUCTION

RPS-Qualitas, as an independent consultancy service highly experienced in the field of acoustics and vibration measurements, is willing to announce a new round of the Proficiency Test AQUS-TUBE_IMPEDANCE_2, on the measure of the sound absorption coefficient in impedance tubes, according to **ISO 10534-2** standard. Therefore, **the Coordinator of the interlaboratory will be RPS-Qualitas** and they will be the responsible organization of the management, monitoring and development of the afore-mentioned intercomparison for providing the interlaboratory activities in this field in order to guarantee the quality of the offered service. Therefore, RPS-Qualitas is responsible for also the tasks of monitoring and control, development of measures, statistical treatment of data and preparation of the report to the participants and Final Global report.

In 2013, the joint organization *ACUSTILAB* with *RPS-Qualitas* successfully managed the intercomparison programme AQUS-TUBE_IMPEDANCE_1. The international intercomparison was designed and developed as a proficiency test. The final report was published in January 2014 after the final meeting with the participants and received an average score of 9,0 out of 10 in the survey dully completed at the end of the meeting.

We are aware of the importance of the intercomparison results as accuracy references for quality control of the laboratories. For this reason we consider convenient to continue providing this type of inter-laboratory service on the measurement of sound absorption coefficient in impedance tubes. Since this is a proficiency test, the aim of the organization is to provide aacurate and reliable results to participants.

The intercomparison program **AQUS-TUBE_IMPEDANCE_2** that we are planning **to develop during the years 2016-2017,** will be performed **according to ISO 17043 standard**, has an unique scope and it is closed in terms of the implementation period. In the intercomparison programme the activities to be performed and its schedule will be specified in detail. It is important to mention that, in contrast to the previous round, in the present exercise **a different type of material** will be testing, showing different absorbing characteristics.

RPS-Qualitas is relying on the technical cooperation of the **Universidad Politécnica de Madrid (U.P.M.), by Professor D. Juan Sancho Gil** belonging to the TSC Department of the same University. This cooperation is mainly focused on the supervision of quality control of acoustic activities needed to perform the tests and to carry out an adequate analysis of the results.

2. OBJECTIVE

The aim is to manage an interlaboratory exercise with the participation of laboratories at European level and other countries around the world in an unique scope, specifically ***"Determination of sound absorption coefficient and acoustic impedance in impedance tubes", part 2: Transfer-function method*** **" according to ISO 10534-2:1998**. Since it is a proficiency test, the performance of participating laboratories will be obtained from the results obtained by all of them, during the measurements of the absorption coefficient sound in third octave bands, by applying the above standard.

Apart from assisting the participants in this proficiency test, with this trial the organizers would also like to know the state-of-the-art related to the precision of the results obtained with this methodology. Accordingly, once completed the exercise and by means of the knowledge acquired during their development, it might be proposed to schedule a collaborative test with the aim of providing practical data on precision, specific to the application of this standard.

2. SCOPE

In terms of the intercomparison **AQUS-TUBE_IMPEDANCE_2,** the present programme will cover the following scope:

- *Determination of sound absorption coefficient and acoustic impedance in impedance tubes", part 2: Transfer-function method* **according to the standard ISO 10534-2:1998**

4 PRACTICAL PROTOCOL

4.1. PLACE OF EXECUTION AND PREREQUISITES

Each participant in this intercomparison will perform the tests **as routine**, in their own facilities, **specifically in the impedance tubes of the laboratory.**

In addition, as a prerequisite to the participation, the participants must communicate to the Coordinator about specific information about their facilities and equipment, by filling the **Technical Pre-registration Sheet** that will be sent to participants together with this Programme previously its official registration.

4.2. MANAGEMENT OF TEST SAMPLES

The Coordinator will manage the acquisition, storage and distribution of the tests samples to each participant. It will send each participating laboratory the volume of sufficient material to carry out the test. Thus, each laboratory will verify that the received material is the specified, the sample received is adequate in terms of quantity, which has come in the right conditions and **must inform the Coordinator as soon as possible, via e-mail,** of the correct reception of the samples.

The manufacturer guarantees that the material to be used as a test sample for all laboratories **came from the same batch of manufacture**.

Samples will be **non-abrasive to allow a good cutting and with two different absorption levels.**

It will be sent to all participants **two types of samples:**

- **Sample A:** Two pieces of material, size A3 of easy handling, uniform thickness and stability over time.

- **Sample B:** Two pieces of material, size A3 of easy handling, uniform thickness and stability over time. Sample B can be of the same material that shows it, but different thickness for the sound absorption coefficient was different depending on the frequency.

4.3. MEASUREMENTS SCHEDULE

By involving a broad set of laboratories dispersed along the European geography and other places of the world, the testing campaign is scheduled to all laboratories in order to perform the intended **tests from 1st December 2016 to 23rd January 2017** .

The exercise is planified so that all the participants **send the tests results before 31st January 2017,** to the Proficiency Test provider.

Once the participation is accepted, each laboratory will receive two documents: **"Basic Execution Protocol**" and **"Excel - File Data and Results",** in which the data obtained during the tests must be included. As it is shown later, in the basic protocol of implementation, each laboratory will carry out four full tests on an ongoing basis in the shortest possible time.

4.4. TEST PROCEDURE

As indicated in the scope, this Proficiency Test will covers a single test consisting of the obtention the sound absorption coefficient in impedance tubes, according to **ISO 10534-2:1998 standard.** Additionally it is allowed results obtained according to the standard ISO 10534-1:1998, taking into account the appropriate precautions.

The values **of absorption coefficient of each test, obtained for discrete frequencies** from the frequency responses of the system used in the measurement, which will be sent to the provider of the intercomparison in sheet 1 of the supplied Excel file. Additionally, the values of coefficient of absorption at discrete frequencies **will be converted using averaged** to values of the coefficient of absorption in third octave, (except in the laboratories that test according to part 1 of the standard.

The promoter will send participants the **Protocol will continue to carry out that transformation**. In sheet 2 of the supplied Excel file will be included the values of the absorption coefficient in third octave, in the range from 100 Hz to 5 kHz both included.

The **results of the absorption coefficient** will be sent **necessarily already rounded with 3 significant figures**, for example: **0.25**

5. TEST PERFORMANCE. SPECIFIC TECHNICAL REQUIREMENTS

Each laboratory must allow test samples to reach equilibrium with respect to temperature and relative humidity before tests are carried out, during 12 hours minimum. This requirement is not enough for exclussion, but it should be pointed out within test results if laboratory carries out this previous treatment or not. It is recommended to have samples of material in the same room that the impedance tubes at least 12 hours prior to testing.

The full test includes sample cutting process and its placement on the inside of the tube. It should be especially careful in the phase of preparation of samples, avoiding its deterioration due to an inappropriate cut.

Each laboratory will prepare 4 samples of each type, which will be used to measure the absorption coefficient in each of the 4 trials to be performed by each type of material. Samples made and used in the measurements will be photographed and saved for possible repetitions. Each laboratory will send the provider a photograph of each of the samples used in the measurements.

Once placed the sample of material on the inside of the tube with the appropriate care, each laboratory will **wait at least 15 minutes before starting the measurement of the absorption coefficient ,** in this way the material adapts to environmental conditions of inside the tube.

It is advisable to **be especially careful** in the assembly of the sample inside the impedance tube, in order to avoid that it change its intrinsic properties.

You must measure and record the values of **temperature, relative humidity of air and atmospheric pressure** at the beginning and end of the execution of each test. The variation of temperature during the test must be less than 1 K.

In addition, each laboratory must:

- Use **your tube or impedance tubes, your samples, your measurement system and auxiliary equipment, their record sheets**, the relevant hearing protectors, etc. And will operate as it does in your usual measures.
- **Each participant must perform 4 complete tests** including the elaboration of the test samples. Four tests of each type of sample is recommended in the working day.
- Other operational aspects that are considered necessary will be indicated in the "**Basic test execution Protocol**"

To perform the tests the laboratories will follow their own procedure that usually apply, both in terms of the personnel responsible for performing them, as to the measurement equipment used and always observing the above mentioned requirements and other ones required by the standard.

When any of these requirements go against any specific procedure, it should prevail whenever possible as described in this Protocol; when it is not possible, the specific aspects that have not been observed together with the results must be reported.

6. PREINSCRIPTION AND TRANSMISSION OF THE RESULTS

In the pre-registration phase, laboratories interested in participating, must be completed formulated questions on the **Technical Pre-registration sheet, which will be sent together with** this Intercomparison Programme.

Each laboratory **will inform the promoter of the intercomparison** of the following issues:

- Method of measurement applied, tube or tubes available and other details relevant to the measurement system.
- Frequency range, which covers measurement system used, calculated as specified by ISO 10534-2:1998, paragraph 4. Exceptionally , it is opened to laboratories that apply part 1 of the standard; in this case they will test to the middle frequencies of the third octave from 100 up to 5000 Hz
- In the case of used two tubes, the participant shall inform the Coordinator of how determined results in a frequency range where two tubes are operating, according to the requirements set out in paragraph 4 of the standard.
- Absorption coefficient of the system received reference sample, and that is used for the correction of phase between channels of the measuring system, or other settings. The absorption coefficient of the reference sample data will be delivered in the discrete frequencies of the measuring system.

When a laboratory shows their interest in participating in this intercomparison program, the first thing you need to do is fill the **Technical Pre-registration sheet** and send it duly completed to the technical partner of this intercomparison (Universidad Politécnica de Madrid - D. Juan Sancho), to the address e-mail: **jsancho@diac.upm.es**

The technical partner undertakes to inform the laboratory and the Coordinator, within a week, on the conformity or otherwise of their participation in the program. If so will be invited to the laboratory to register, should formalize it in a **within 7 days after receiving the acceptance.**

Once the registration process has been completed, participants must make the relevant payment in advance.

Formalized registration, when evidence of having made the appropriate payment, the Promoter will send to each participant laboratory "**sheets of two types of material"** that will be used to prepare samples for testing, **"The Basic execution Protocol"** and **"the Excel file data and results"**. The deadline for Coordinator supply the test material and the documents cited to each participant, it will be **30th November, 2016**.

To avoid transcription errors or clerical mistakes, laboratories will send in the pre-set format, data and results of tests, attaching the filled **"file data and results"** to the message forwarded to RPS-Qualitas, via email. If necessary, the instructions for use willl be indicated in the same "**Excel file data and results"**.

The file **"data and results**" duly completed, must be sent to the Coordinator, **within not more than 10 working days from the date that each participating laboratory has completed its tests**. They should be sent to the e-mail address: **pedro.rosario@rpsqualitas.es** **before the 31st January 2017**

In the event of no data have been received after the deadline from any participating laboratory in the agreed period of time, **RPS-Qualitas will contact with the laboratory**, in order to clarify the reason which had prevented the reception of the results, and find out if any problem happened in the transmission electronic information, not imputable to the laboratory.

6.1 EXCLUSIONS

There will not be accepted:

- Data and results sent after the stipulated deadline
- Data or results received in different to the pre-set formats.
- Data or incomplete received results.

6.2. CORRECTION OF RESULTS

Corrections of data and/or results sent, only will be accepted i**f written request** is received and always **within the specified deadline** in this Programme.

6.3 CONTENT OF THE REGISTRATION FILE

The file used for transmission of data and results must be filled up and sent in an Excel format, with the following minimum content:

- Identification of the laboratory
- Identification of the person responsible for tests
- Identification of the used equipment
- Results of measures and units
- Estimated uncertainty of the measures (optional)
- Sample data
- Data of the measurements
- Data of environmental conditions
- Comments

6.4 DELIVERY OF THE RESULTS

The results of the intercomparison will be sent to participating laboratories by the end **of March 2017**.

6.5 ENTITIES INVOLVED IN THE MANAGEMENT

The following entities are represented and involved in the performing of tasks related to this proficiency test:

- Promoter / PT Provider: ***RPS-Qualitas***
- Other coworker Entities (technical partner):
  - ***Universidad Politécnica de Madrid – UPM***
- Statistical treatment of data: ***RPS-Qualitas***

6.6 TIMELINE OF MAIN ACTIVITIES

The content of the schedule is defined in **Table 2** of the present document.

7. CONFIDENTIALITY

RPS-Qualitas, as the coordinator entity that will manage the data and results of the laboratories, will assign a confidential alphanumeric code to each participating entity, that will accompany it during the whole programme until the final report is issued. This single identification code shall be only traceable for RPS-Qualitas with each participating laboratory.

To make public the list of participating laboratories, should not have opposition explicit by writing to the ***RPS-Qualitas*** by any of the participants.

8. QUALITY ASSURANCE

RPS-Qualitas commits to the proper execution of the services covered by this programme, in accordance with the requirements set out in the technical notes of Accreditation Bodies rules and regulations, with the principles of good practice accepted by the organizations that offer this type of service. Specifically, it tend to apply the requirements set out in **ISO 17043: 2010** standard which regulates proficiency testing schemes.

To achieve adequate standards of quality of the intercomparison, various controls will be carried out by the Organization designed to ensure both testing conditions and compliance with applicable regulations in the scope. For this, the following actions have been defined:

- The distribution of the sample will be done by RPS-Qualitas, by sending each laboratory participating enough material immediately once participation has been confirmed.

- At the beginning, before the period of testing, it will run **tests of homogeneity**. A laboratory accredited by ENAC (ISO 17025) will perform these tests.

- At the end of the testing period, the same laboratory will repeat tests on the same samples, to determine the **stability of the sample** throughout the campaign measures.

- The Organization of the program will carry out a comprehensive analysis of the results of the intercomparison and shall inform participating laboratories wishing to do so through a **final with the participants, meeting** to celebrate **end of April 2017. <u>There will be the possibility of video conferencing</u>** to facilitate the participation of those laboratories which for geographical reasons or agenda can not attend in person at that final meeting.

9. STATISTICAL ANALYSIS

9.1. REFERENCES

- UNE 82009-2:1999, equivalent to the standard ISO 5725-2:1994
- ISO 17043:2010
- ISO 13528:2015

9.2. STATISTICAL EVALUATION

Depending on the statistical distribution of the data submitted by the participants, the most suitable approach from the rules indicated in the previous point will be applied in each case. Therefore, the proposed approach may be classic statistical treatment (which includes testing of differing outliers values) or the application of robust statistical data analysis (which minimize the contribution of anomalous values through appropriate robust algorithms).

- **Assigned or reference value.**
  It will be obtained from the results of all participants, calculated as the value of consensus among the results of all participants, either once excluded outlier values or by calculating the robust mean.
  This value will be used as a reference value of each test, both in the results expressed in one-third octave bands as in the case of global values.
  It could also include an estimation of the uncertainty of the assigned value, determined on the basis of the statistical technique used.

- **Standard deviation of the intercomparison.**
  It is usually determined on the basis of the participant results from the calculation of the standard deviation of reproducibility (SR), although depending on the statistical distribution of the results it can also be calculated using robust methods of analysis according to the standard ISO 13528.

Notwithstanding the estimation of the repeatability and reproducibility values of the proficiency test, requirements obtained externally, either from normative references or other technical criteria that evaluate the precision may exceptionally be used.

9.3. ASSESSMENT OF PERFORMANCE OF THE PARTICIPANTS

The evaluation of the results of the participants is performed from the values listed above or from other possible options, calculating **the Z-score index** which allows to evaluate the performance of each laboratory.

9.4. CONTENT OF THE FINAL REPORT

Each participant will be provided a comprehensive report according to the scope in which he has agreed to participate effectively, with the following content:

- Table with the results of the participating laboratories
- Graphical representation of the laboratories results
- Value for each parameter and scope
- Uncertainty estimation of the reference value and acceptable ranges depending on the reproducibility of the measurements
- Graphical representation of the standardized values of Z-score index of each laboratory for each parameter, with the possibility of including combined indexes of performance.

9.5. CONTENT OF THE GLOBAL REPORT

A Final Global Report with the overall results of the exercise will be initially provided to participants; if any indication against is not received from any participant in a specified time, this report shall be issued as a public edition .

10. SUGGESTIONS AND COMPLAINTS

According to the policy of RPS-Qualitas with regard to their activities, it is pointed out that always under the point of view of achieving continuous improvement of quality, we are open to suggestions from the participating laboratories.

On the other hand, the Organization undertakes to give necessary attention to any dissatisfaction or complaint, which will be analysed and answered within a maximum period of one month after the reception.

11. COST

11.1. COVERED ACTIVITIES

- Cost of sample, storage and distribution.
- Administrative management of the project.
- Use of English and/or Spanish in all documents and communications with participants
- Measures of the stability of the sample.
- Attention to the participating laboratories.
- Statistical analysis of the data and results.
- Preparation of the final report.

11.2. COST BY PARTICIPANT

The **cost by participant is indicated in Table 1. (IVA tax free)**

	FEES	***FEES***
Measurement parameter Test standard	**EUROPEAN COUNTRIES GENERAL FEE Euros (€)**	**OTHER COUNTRIES (Non European Countries) Euros (€)**
ISO 10534-2:1998 "*Determination of sound absorption coefficient and acoustic impedance in impedance tubes", part 2: Transfer-function method*".	**650**	**800**

Table 1: **Table of fees.**

12. REFERENCES

- **ISO 10534-2:1998** - "Determination of the coefficient of sound absorption and acoustic impedance in tubes of impedance, part 2: method of transfer function"

- **ISO 5725-2:2002 –** "Accuracy (trueness and precision) of measurement methods and results - Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method"

- **UNE 82009-2:1999** - "Accuracy (accuracy and precision) of measurement methods and results. Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method".

- **ISO/IEC 17043:2010 – "** Conformity Assessment – General Requirements for Proficiency testing "

- **ISO 13528:2015 -"** Statistical methods for use in proficiency testing by interlaboratory comparisons".

- **Guide EURACHEM (2nd ed. - 2011) -** "Selection, use and interpretation of proficiency testing (PT) schemes"

REGISTRATION FORM

IDENTIFICATION OF PARTICIPANTS LABORATORIES				
Name of the participant laboratory				
Responsible for			**Phone**	
CIF/VAT				
Address			**Zip code**	
City			**Province**	
Phone		**E-mail**		

Mark with an X the scope you want to participate.

REQUESTED SCOPE	
ISO 10534-2:1998 "*Determination of the coefficient of sound absorption and acoustic impedance tubes in impedance*"	

Note: The fee is indicated in table 1 of Protocol (page 12).

DATA from the laboratories for SHIPMENT OF SAMPLES				
Name of the participant laboratory				
Responsible for			**Phone**	
Address			**Zip code**	
City			**Province**	
Phone		**E-mail**		

CONTACT INFORMATION FOR AFFAIRS ADMINISTRATIVE RELATED TO BILLING			
RPS-QUALITAS	c/ Marqués de Corbera, 62 ,28017 Madrid	**CIF**	**B-84371251**
Contact person	Pedro Rosario Ruiz	Teléfono	34 628 88 55 24
Email	**rps@rpsqualitas.es** **pedro.rosario@rpsqualitas.es**		
Transfer to Nº (IBAN)	**ES28 2038 1861 6660 0023 6162**		
BIC/SWIFT Code	**CAHMESMMXXX**		
Reference Transfer	**Intercomparison AQUS-TUBE_IMPEDANCE_2**		

Registration conditions:

- Entries must be made **in writing by email**, simply by filling in the spaces of the present **registration form** and enclosing proof of payment.
- Registration for the intercomparison program is not effective until you do not carry out income accounted for in advance to the indicated bank account.
- For reasons of logistics, it is appreciated that you make **registration before the 31 October 2016**.
- **RPS-Qualitas reserves the right to cancel the realization, when the number of participants is insufficient, in which case it shall refund all amounts paid by the participants.**
- Amounts will only be refunded to that laboratory which has been able to realize trials for reasons attributable to the organizers of the exercise.

Registration conditions:

- Entries must be made **in writing by email**, simply by filling in the spaces of the present **registration form** and enclosing proof of payment.
- Registration for the intercomparison program is not effective until you do not carry out income accounted for in advance to the indicated bank account.
- For reasons of logistics, it is appreciated that you make **registration before the 31**

ANNEX 1

TABLE 2: TIMETABLE: AQUS-TUBE_IMPEDANCE_2

Actions	Responsible for	October			November				December				January 2017				February 2017				March 2017				April 2017			
		2ª	3ª	4ª	1ª	2ª	3ª	4ª	1ª	2ª	3ª	4ª	1ª	2ª	3ª	4ª	1ª	2ª	3ª	4ª	1ª	2ª	3ª	4ª	1ª	2ª	3ª	4ª
Tests Control	RPS-Qualitas																											
Management samples	RPS-Qualitas																											
Testing	Laboratories																											
Reception and data management	RPS Qualitas																											
Statistical treatment	RPS-Qualitas																											
Analysis results	RPS-Qualitas																											
Report participants	RPS-Qualitas																											
Final meeting	RPS - Qualitas																											

Table 2: Timetable of implementation of main activities

Madrid, 19th September 2016