ExTAG/580/R
August 2019

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC) SYSTEM FOR CERTIFICATION TO STANDARDS RELATING TO EQUIPMENT FOR USE IN EXPLOSIVE ATMOSPHERES (IECEx SYSTEM)

Title: Report from Tim Krause, Convenor ExTAG WG 10, Proficiency Testing

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INTRODUCTION

This document is a report prepared by Mr. Tim Krause the Convenor of **ExTAG WG10, Proficiency Testing.** The report will be presented by Mr. Tim Krause during the ExTAG 2019 Dubai (UAE) Meeting for discussion and consideration.

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Report by the convenor of ExTAG WG 10 "Proficiency Testing", Tim Krause, for the ExTAG Meeting in Dubai (UAE) 2019

1. News about the IECEx Proficiency Testing Scheme

Program "Explosion Pressure - Test Round 2017" ended in October 2018 and program "Pressurized Enclosure - Test Round 2017" ended in January 2019 with the publication of the final reports.

With the practical experience gained day by day in the performance and organization of PT programs, the IECEx Proficiency Testing Scheme shall be further developed and improved (continuous improvement process). After each PT program cycle a critical review of the whole performance is done to highlight the potential of improvement. As a result of this critical review process a package of measures will be adopted to eliminate weak points of the PT scheme. Helpful for this process is a survey at the end of each program cycle to get feedback from the participants concerning the organization and performance of the tests. The results of that survey have been evaluated by the coordinator and have been published in April 2019 for all participating laboratories. The feedback has been used and analysed to improve the management system, PT programs, and customer service.

(Attachment included at the end of this report as Annex A)

The results, experiences and findings from the programs "Explosion Pressure - Test Round 2017" and "Pressurized Enclosure - Test Round 2017" were presented at the TC31 Meetings MT 60079-2 and MT 60079-1 in Waldenburg in March/April 2019.

The two new programs/test rounds of cycle 2019/2020 are "Tests of Enclosures - Test Round 2019" and "Battery Testing - Test Round 2019". The programs have been rolled-out in March 2019. Program "Spark Ignition - Test Round 2010" was closed and is therefore not available anymore. There are currently eight programs available:

- Flame Transmission – Test Round 2013
- Temperature Classification – Test Round 2013
- Electrostatic Charge – Test Round 2015
- Intrinsic Safety – Test Round 2015
- Explosion Pressure – Test Round 2017
- Pressurized Enclosure – Test Round 2017
- Tests of Enclosures – Test Round 2019
- Battery Testing – Test Round 2019

There will be an update of the Ex PTS website regarding technical background and layout in August 2019.

The IECEx Proficiency Testing Scheme celebrates its 10th anniversary this year.

2. Status of the current programs 2019/2020 "Tests of Enclosures" and "Battery Testing"

Description of program "Tests of Enclosures": For the program "Tests of Enclosures ("TE") - Test Round 2019" the general routine procedure is described by the standard "Explosive atmospheres - Part 0: Equipment – General requirements" - IEC 60079-0, Edition 7.0 and "Degrees of protection provided by enclosures (IP Code)" - IEC 60529, Edition 2.2.

Enclosures used in the field of explosion protection must meet certain criteria and be subjected to certain tests. These tests are defined in the standards mentioned above. Essential characteristics for testing and assessing explosion protection are tests on enclosures for resistance to impact and for protection of the equipment inside the enclosure against ingress of solid foreign objects (dust) and water. Therefore, compliance with the degree of protection (IP) has been selected as the characteristic of interest which is to be compared in the program "Tests of Enclosures - Test Round 2019". Next to this characteristic of interest, other aspects like "how to perform the thermal endurance test" and the comparison of test conditions during the performance of tests will be analyzed. Due to the better practicability of the program, a selection of enclosure tests is carried out which are partly shortened or modified compared to the requirements of the standards.

The workload to perform this program is approximately 3 working days (separated by additional waiting periods due to thermal endurance tests and IP testing).

Figure 1: Test Sample "EP" in dust chamber

Status of program "Test of Enclosures": As of today (2019-08-14), a total of 83 Ex laboratories (71 IECEx test laboratories) have registered for the program. 11 IECEx test laboratories have not registered or have not paid the program fees, although they have the standard IEC 60079-0 in scope. The IECEx Secretariat and the IECEx PTS Provider follow up and are in contact with these IECEx test laboratories. It can be assumed that the number of non-participating IECEx test laboratories will decrease in the next four weeks.
The schedule of the program is on time. The test samples will be shipped in August 2019. The documentation and templates, necessary to perform the program, will be available at the end of

August 2019. The deadline for uploading the results of Phase I is the 20th of December 2019. The interim report will be published at the end of February 2020. The PT Workshops 2020 are scheduled for 25th to 28th of May 2020. After the PT Workshops 2020, Phase II will start. The deadline for uploading the results of Phase II is the 31st of August 2020. The program test round will be completed with the final report in October 2020.

Description of program "Battery Testing": In the program "Battery Testing" ("BT"), the selected quantities, which are to be compared (measurand of interest), are the maximum surface temperature and the internal resistance of batteries.
As already mentioned in the "Roll Out Paper", the general routine procedure is described in the standard "Explosive atmospheres - Part 11: Equipment protection by intrinsic safety "i"" - IEC 60079- 11 Edition 6.
The measurands of interest shall be determined with the Test Sample "BT" in accordance with clause 10.5.3 of IEC 60079-11 using the usual procedures of the respective laboratory. 10 tests of battery shall be performed by each participant for each phase of the program "Battery Testing". The workload to perform this program is approximately three working days.

Figure 2: Test Sample "BT"

Status of program "Battery Testing": As of today (2019-08-14), a total of 77 Ex laboratories (69 IECEx test laboratories) have registered for the program. 9 IECEx test laboratories have not registered or have not paid the program fees, although they have the standard IEC 60079-11 in scope. The IECEx Secretariat and the IECEx PTS Provider follow up and are in contact with these IECEx test laboratories.
The schedule of the program is on time. The test samples will be shipped in August 2019. The documentation and templates, necessary to perform the program, will be available at the end of August 2019. The deadline for uploading the results of Phase I is the 20th of December 2019. The interim report will be published at the end of February 2020. The PT Workshops 2020 are scheduled for 25th to 28th of May 2020. After the PT Workshops 2020, Phase II will start. The

deadline for uploading the results of Phase II is the 31st of August 2020. The program test round will be completed with the final report in October 2020.

3. Revision of IECEx OD 202 Edition 2 "IECEx Proficiency Testing Program"

Two years of working with Edition 2 of the IECEX OD 202 has shown some issues with this document and its implementation in the daily work. A revised draft version has been prepared by ExTAG WG10. The draft is submitted as **ExTAG/574/CD** and will be presented to both the ExTAG and ExMC 2019 Dubai Meetings, by the ExTAG WG10 Convener Mr Tim Krause.

4. PTB Ex PT Workshops 2020

The PTB Ex PT Workshops 2020 will take place in the week 25th May 2020 to 28th May 2020 at PTB. The topics are associated with the current programs "Test of Enclosures – Test Round 2019" and "Battery Testing – Test Round 2019". The structure of the workshops consists, as usual, of a theory part and a practice part for each program. For each of the programs there will be two days of workshop.

There are plans to have an identical workshop held in China (Shanghai) in 2020 to handle the very high demand of participants and to provide an easier travel for interested people especially from the Asia/Australian region.

5. Any other business

Agenda of the next ExTAG WG10 meeting

Date and time: 23rd September 2019 (08:00 - 09:00 - "early morning meeting")
Venue: Sofitel Dubai Downtown, meeting room/secretariats room (to be announced)
Number of participants: About 10 people (max.)

1. News about the IECEx Proficiency Testing Scheme
2. Status of the current programs 2019/2020 "Tests of Enclosures" and "Battery Testing"
3. Revision of IECEx OD 202 Edition 2 "IECEx Proficiency Testing Program"
4. PTB Ex PT Workshops 2020
5. Any other business

PTB survey after the end of the PTB Ex PT Programs "Explosion Pressure (EP)" & "Pressurized Enclosure (PE)" of cycle 2017/2018

The red colored numerical values inside the brackets represent the mean values of the replied participants evaluation. Under section 6, 7 and 8 the respective feedbacks of the participants are listed. Under section "Conclusion" a short statement of the provider is made and first actions to improve future programs are described.

The number of received feedback was 36.

1. Overall performance of the programs "EP" and "PE":

a) "EP" [8.9]
b) "PE" [6.5]
(10 = very good – 0 = very poor)

2. Please evaluate the following aspects concerning the program "EP":

a) concept [9.1]
b) processing [8.8]
c) support [9.2]
d) reporting [8.7]
(10 = very good – 0 = very poor)

3. Please evaluate the following aspects concerning the program "PE":

a) concept [6.8]
b) processing [6.2]
c) support [7.6]
d) reporting [7.0]
(10 = very good – 0 = very poor)

4. Did you feel that the programs caused a certain impact on your daily in-house procedures?

a) [5.9] (10 = strong impact – 0 = no impact)

5. How long was the estimated in-house operation and processing time (in hours) you have spent for:

a) "EP" [40.4]
b) "PE" [48.0]
c) Was this time too long [7 + 2 (only PE)] or appropriate [25 + 2 (only EP)]? (just tick your selection)

6. What did you like about the programs?

- In the EP program, the test sample is appropriate, and the instructions are clear and detailed to perform the tests. It is also very nice to compare the results to others and find some reasons which are important to influence the tests, so that test method could be improved.
- EP Program is very good experiment. Straightforward method, aligning with the standard. It was also interesting to see the comparison among labs using precompression vs reduced temperature.
- It was very helpful to check in-house test procedure and improve in-house test procedure.
- It was very good to meet the people from other testing laboratories and discuss about the problems of measuring and interpretation of the results.
- The programs were a nice opportunity to check our testing competence and methodology and to compare the results with the results obtained by other testing laboratories in this field.
- Good organization and efficient support during the programs, justification of the measurements, increase of the experience
- Exchanging of experience and knowledge, validation of operating mode and instrumentation used.
- The improvements we had to make to enable the testing.
- The support for both programs was very good and the coordinators were very knowledgeable and helpful.
- Practicum with Kistler.
- The tour through PTB laboratory
- For the “EP” program, from the comparison of reference pressures measured at the lower temperature -40C and increased pressure at normal temperature, we learned some things about our setup. EP program was solid and helped by the fact there had been the original EP programme. All reasonably straightforward.
- For the “PE” program having comparable data for a standard for which we perform the applicable type tests not that much and most only as field certification.

7. What did you not like about the programs or what could be improved?

- The PE program could use a more consistent, better built sample. The test sample is not suitable for an exact and reproducible comparison measurement. The instructions should be more specific as not to be able to be interpreted in different ways. It takes too much time to read all the documents.
- There was suddenly a second phase of testing for the „PE“. It was also hard for us to measure program „PE“ phase 2 because we didn´t manage the time for this test before.
- Too much confusion for the execution of the “PE” test.
- The published results are difficult to understand. We really need a summary at the start of the results to say how good (or bad) we are. For example: 95% of results from ExTL are within 5% of the determined value.
- The report also is too lengthy, with a lot of information about the statistical procedures and explanations that could simply be placed in a separate document to be read as an attachment."
- The interim report should be published before the workshop and No hand out during the workshop.
- „PE“ program was very difficult for evaluation. The measuring depended on many factors which influenced the results. Maybe it would be better to do some pre-tests and just after those experiences it will be clear defined the setup and procedure of the measurement. It was also hard for us to measure program „PE“ phase 2 because we didn´t manage the time for this test before.
- There was significant delay in getting samples for the PE program. There was a revision to the procedure for the PE program in the middle of the test period.
- The Excel of measures could be a little more specific with the time units of the values measured
- Small internal volume of the enclosure caused ambiguous results and non-consistencies
- There are big discrepancies between input data and output results. Some expected results were not reported (leakage rate). The results were not presented as expected in the way was established in the program (concentrations) but was reported (number of passed points). The z score was not reported (but, of course we had computed it).
- The comparison and data work from PE testing, when giving in a measured value, the value should be analyzed and not the pass fail criteria.
- It had not offered which parts need to improve to each participants so I think that it needed to improve.
- To perform the PTS, sometimes the applicant has to prepare some instruments which only needed for the program. For example flow meter for ""PE"" program. It should be provided by the organizer for the items.

- The PE program shall be restarted with the knowledge of the work in this cycle. In some cases shall the PTB work with another EXTL to find the best version of the test sample or the test self. It can be help by a new PE program.
- To improved and clarified necessity and method of dynamic and/or static calibration of transducer in EP program
- The theory discussions during the workshop could be longer or more in depth, and / or some literature shared as part of the program.
- The sensitivity of our test equipment and the role that played in test results should be mentioned in the test program since the standard does not touch on it – particularly with regard to CO2. There should be clarification in the test procedure where (what source) should serve as the ambient O2 content; for instance, should ambient (~21%) O2 be sourced from the surrounding air for the test, or from the purge air that may be sourced by a compressor.

Future programs

8. Which future PT programs for the PTB Ex PTS would you welcome with which priority?

- Maximum surface temperature for type of protection “d” or temperature test for dust layer according to IEC 60079-0
- Transferred Charge Test according to IEC 60079-0
- Measuring optical radiation with different light sources according to IEC 60079-28
- Battery tests according to IEC 60079-11
- Spark testing according to IEC 60079-11
- Flame transmission according to IEC 60079-1
- Testing of cable glands according to IEC 60079-0
- Test of configuration according to IEC 60079-1
- Resistance to impact according to IEC 60079-0
- Maximum surface temperature according to IEC 60079-0
- Small component ignition test according to IEC 60079-0
- “op is” testing according to IEC 60079-28
- Explosion testing on electric motors according to IEC 60079-1
- Tests for enclosures according to IEC 60079-0
- Pressure testing of bushings
- Sealed device test
- Enclosed break device
- Non-incentive sparking component testing

Thank you very much!

Conclusion

The feedback from 36 participants of the PT Programs “Explosion Pressure – Test Round 2017” & “Pressurized Enclosure – Test Round 2017” is very helpful for a critical analysis and significantly important for the improvement of the design, description and analysis of future programs. The whole feedback and especially section “What did you not like about the programs or what could be improved?” has been discussed intensively within the PT provider team and PTB experts and led to a catalogue of measures for future activities.
The evaluation for the overall performances and the quality of detailed aspects is analyzed separately due to the significant difference in the evaluation of the programs.

Program “Explosion Pressure - Test Round 2017”

The evaluation for the overall performances of “8.9” and the quality of detailed aspects in the range from “8.7” to “9.2” is satisfying with room for improvement.
The average of the estimated in-house operation and processing time of “40.4” hours is higher than the workload of three working days previously estimated by the provider. The range is from 20 hours to 80 hours which shows that the expenditure of time is depending on the participant considerably. Nevertheless, it can be seen that the program expenditure was rather underestimated.

Program “Pressurized Enclosure - Test Round 2017”

The evaluation for the overall performances of “6.5” and the quality of detailed aspects in the range from “6.2” to “7.6” is not satisfying and it leads to consequences. The feedback was to be expected and, from the providers point of view, is essentially caused by the difficulties with the test sample. The need of the test sample to meet the requirements of homogeneity, stability, practicability and the reference to real test samples for equipment protection by pressurized enclosure "p" has caused difficulties, which were not solved in a satisfactory way in Phase I of the program. In the preparation phase it was necessary to measure each test sample completely by the provider to assure meaningful results. The process was extremely time-consuming and not intended in the original program design, but absolutely necessary. This resulted in delays throughout the whole program. A design flaw (foam rubber as sealing material) then led to difficulties in performing Phase I, which resulted in an unscheduled adjustment of the test sample and the Phase II procedure. This, in turn, led to increased effort on the part of the participating laboratories, which had to carry out the measurements a second time. This situation did not correspond to the typical course of the program but was necessary in order to obtain comparable and meaningful results. Despite of the difficulties, we have finally obtained meaningful results and outcomes from the program. However, the way was very difficult and must not be repeated in this way. To guarantee this, we have adapted measures with regard to the development of future program and test sample designs.
The average of the estimated in-house operation and processing time of “48” hours is higher than the workload of 3 working days previously estimated by the provider. This is due to the necessary repetition of the measurements in Phase II. The range is from 24 hours to 120 hours which shows that the expenditure of time is depending on the participant considerably.

Both programs

Nine participating laboratories felt the expenditure of time for the programs was too high. 27 participants declared that the time required to perform the programs was acceptable.

The average result of “5.9” for a certain impact on daily in-house procedures shows that in addition to the possibility of performance evaluation, the programs are also used for participants to adapt

internal processes. The range from “0” to “10” shows that this depends on the participant considerably.

The section of free discussion of “what did you like / not like” led to different short, medium- and long-term measures. These measures depend strongly on the programs. Nevertheless, some general changes are already decided to be changed for future programs:

- Restructuring of the design phase for prototypes of the test samples and an increase in the preliminary tests
- Streamlining of program processes and concentration on relevant parameters
- Parameters that are actually used as a basis for error handling and discussion between provider and participant, but are nevertheless of interest to the public of the participating laboratories, will be evaluated and published in the future (reports)
- The information content of the shipping documents will be increased in order to counteract growing problems with customs clearance of different destination countries
- The interim reports will be published prior to the workshops to discuss the results with the participants during the workshops

Basically, it must be pointed out that the design, processing, analysis, evaluation and reporting of the programs have to fulfill the requirements of ISO/IEC 17043 “Conformity assessment — General requirements for proficiency testing” which significantly restricts flexibility, for example in shortening reports. The PT provider always strives to fully meet the requirements and to provide participants with a professionally designed, practical program and a clear summary of results and findings in order to continually improve the comparability of our test results and methods.