

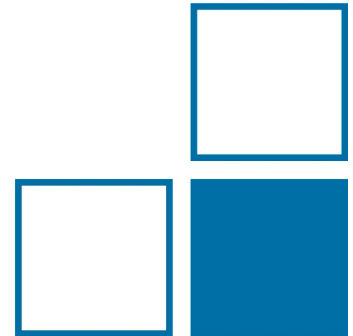


Physikalisch-Technische Bundesanstalt
Braunschweig and Berlin
National Metrology Institute

IECEx / PTB Ex Proficiency Testing Program Spark Test Apparatus Sensitivity “STAS2025”

2026 IECEx Annual Meeting

Jia Wu, 14th of September



PTB Program “STAS2025”

- Normative background: IEC 60079-11, Edition 7.0, clause 9.1.2 and 9.1.3
- Principle: Check the sensitivity and over-sensitivity of the spark test apparatus according to the Table 23 and 24 of IEC 60079-11
- Measurand of interest:
 - Number of revolutions until ignition (sensitivity check)
 - Number of ignitions (over-sensitivity check)
- Test sample:
 - a (95 ± 5) mH air-cored coil provided by PTB;
 - own air-cored coil and tungsten wires used in routine procedure
- Scope of testing: three test repetitions



Program “STAS2025”

- The tests for program “STAS” consist of the following three parts:
 - Part 1.** Testing the sensitivity and over-sensitivity for all explosive test mixtures listed in Table 23 and Table 24 of IEC 60079-11:2023, Edition 7.0 using the participant's own tungsten wires and the Test Sample “STAS” from the provider,
 - Part 2.** Testing the sensitivity and over-sensitivity for the explosive test mixture for the Equipment Group IIC as specified in Table 23 of IEC 60079-11:2023, Edition 7.0 ((21 ± 2) % hydrogen in air) using the participant's own tungsten wires and own (95 ± 5) mH air-cored coil,
 - Part 3.** Testing the sensitivity and over-sensitivity for the explosive test mixture for the Equipment Group IIC as specified in Table 23 of IEC 60079-11:2023, Edition 7.0 ((21 ± 2) % hydrogen in air) using the tungsten wires and the Test Sample “STAS” from the provider.

Table 23 – Compositions of explosive test mixtures adequate for 1,0 safety factor

Equipment Group	Compositions of explosive test mixtures	Calibration current for ignition mA	Minimum calibration current for no ignition mA
	Vol. % in air		
I	(8,3 ± 0,3) % methane	110 to 111	87
IIA	(5,25 ± 0,25) % propane	100 to 101	79
IIB	(7,8 ± 0,5) % ethylene	65 to 66	51
IIC	(21 ± 2) % hydrogen	30 to 30,5	23

Table 24 – Compositions of explosive test mixtures adequate for 1,5 safety factor

Equipment Group	Compositions of explosive test mixtures Volume %					Calibration current for ignition mA	Minimum calibration current for no ignition mA
	Oxygen-hydrogen-air mixture			Oxygen-hydrogen mixture			
	Hydrogen	Air	Oxygen	Hydrogen	Oxygen		
I	52 ± 0,5	48 ± 0,5	–	85 ± 0,5	15 ± 0,5	73 to 74	57
IIA	48 ± 0,5	52 ± 0,5	–	81 ± 0,5	19 ± 0,5	66 to 67	51
IIB	38 ± 0,5	62 ± 0,5	–	75 ± 0,5	25 ± 0,5	43 to 44	33
IIC	30 ± 0,5	53 ± 0,5	17 ± 0,5	60 ± 0,5	40 ± 0,5	20 to 21	16

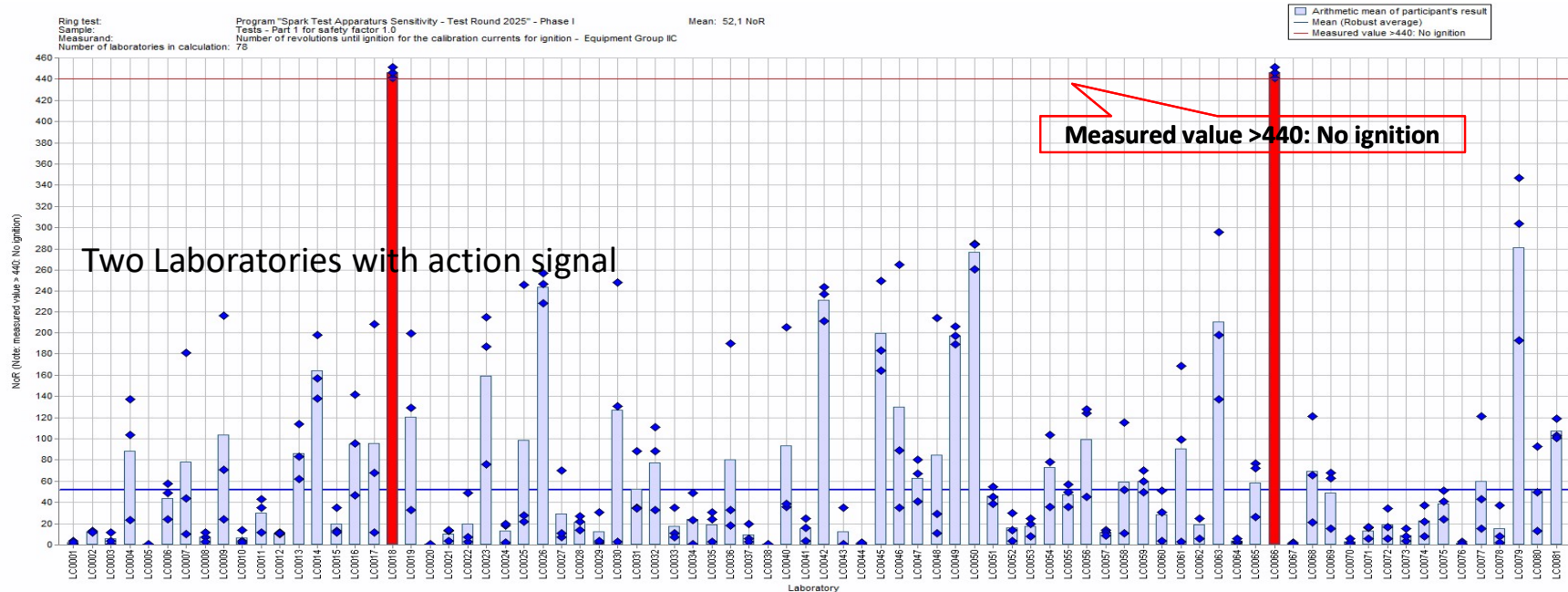
- Performance evaluation of participants' results (results of the sensitivity and over-sensitivity check according to Table 23 of IEC 60079-11:2023)

Sensitivity and over-sensitivity check according to Table 23 of IEC 60079-11:2023	Evaluation basis
Sensitivity check (using the current of the “ignition” column)	Three ignitions occur within 440 revolutions. Warning signal: No ignition (x1) or No ignition (x2) Action signal: No ignition (x3)
Over-sensitivity check (using the current of the “no-ignition” column)	No ignition occurs within 400 revolutions. Warning signal: Number of ignitions = 1 or 2 Action signal: Number of ignitions = 3

Warning signal: Participants should be advised to check their measurement procedures following warning signals in case they indicate an emerging or recurrent problem

Action signal: indication of a need for action arising from a proficiency test result

- Number of revolutions until ignition (sensitivity check acc. Table 23) – EG IIC

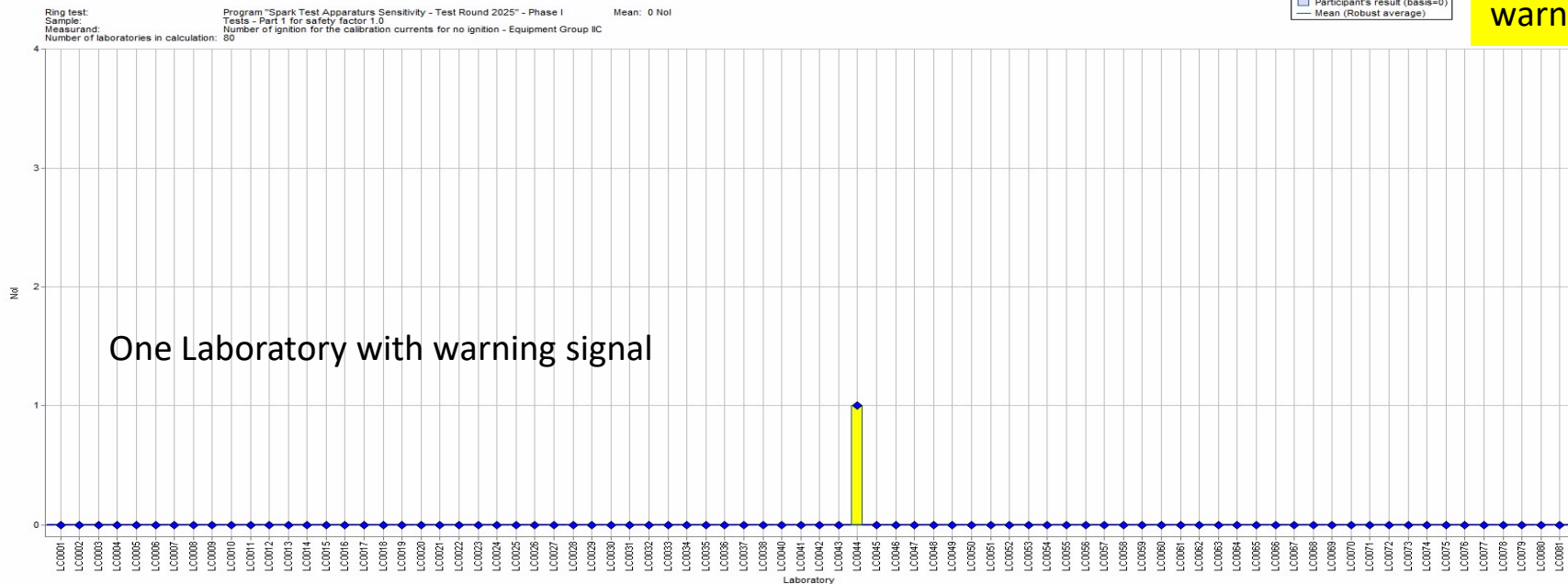


Overview for the sensitivity check acc. Table 23	Equipment Group	Laboratories with warning signal	Laboratories with action signal
Sensitivity check	EG I	No	No
	EG IIA	No	No
	EG IIB	No	No
	EG IIC	No	LC0018, LC0066

- Number of ignitions (over-sensitivity check acc. Table 23) – EG IIC

1 Laboratories
with action signal

2 Laboratory with
warning signal.



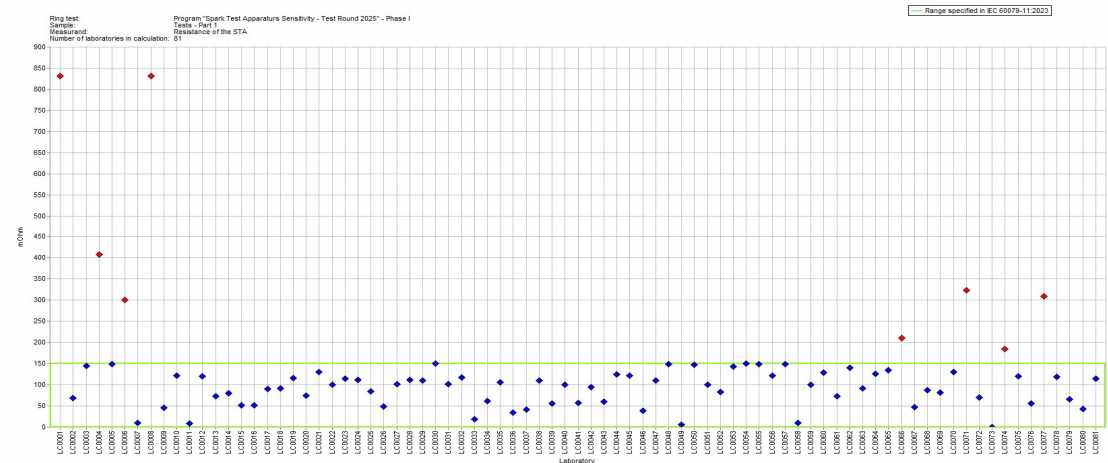
Overview for the over-sensitivity check acc. Table 23	Equipment Group	Laboratories with warning signal	Laboratories with action signal
Over-sensitivity check	EG I	No	No
	EG IIA	LC0066	LC0067
	EG IIB	LC0066	LC0067
	EG IIC	LC0044	No

13 Laboratories
with action signal

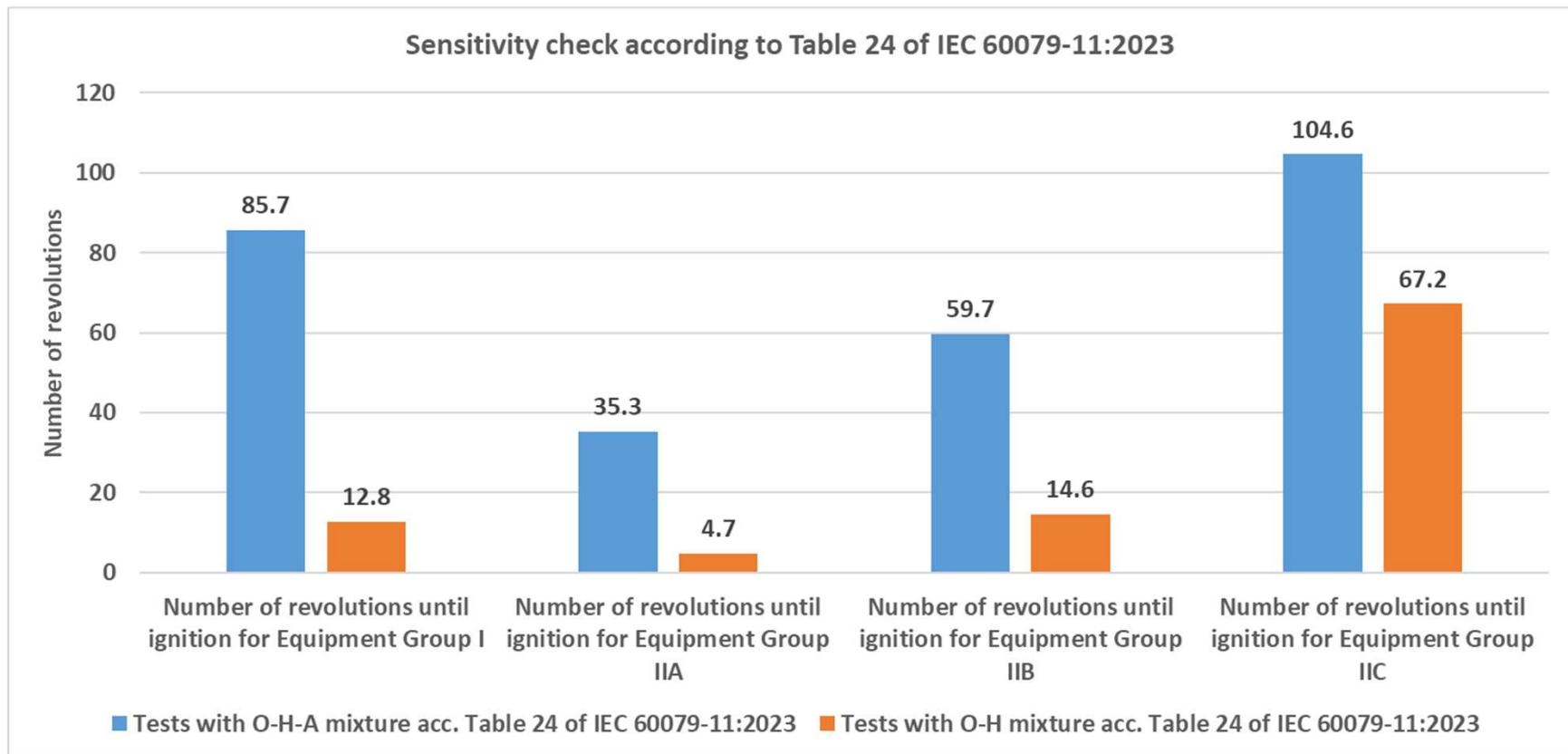
- Performance evaluation of the parameters of the STA

Parameters of the STA	Requirements in IEC 60079-11:2023	Evaluation basis	Laboratories with action signal
Number of revolutions per minute of wire holder in r/min	78-82	Action signal: Value outside the range specified in the standard.	LC0016, LC0042, LC0074
Resistance in mΩ	≤ 150		LC0001, LC0004, LC0006, LC0008, LC0066, LC0071, LC0074, LC0077
Self-capacitance in pF	≤ 30		LC0006, LC0077, LC0044
Self-inductance in μH	≤ 3		LC0015, LC0066, LC0081

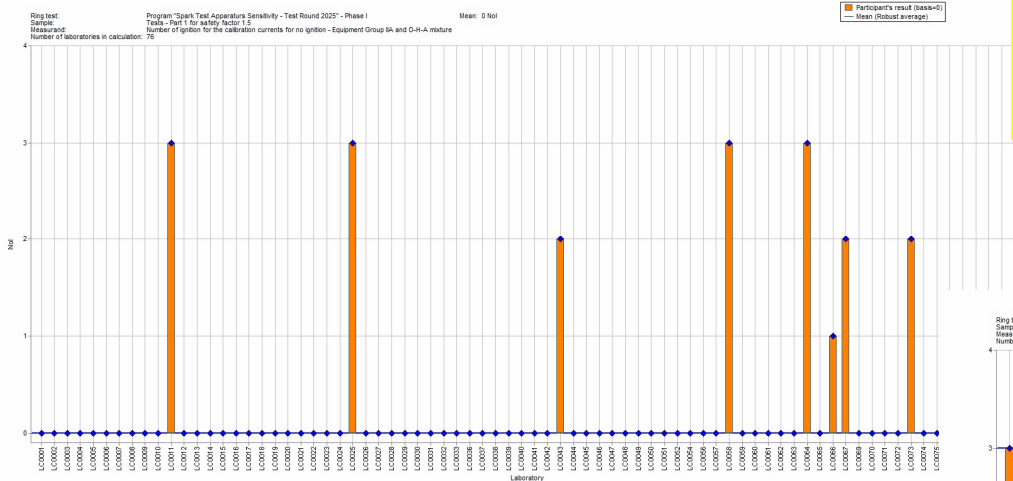
- Results of resistance of
the STA from participants



- Results of the **sensitivity** check according to Table 24 of IEC 60079-11:2023, Edition 7.0



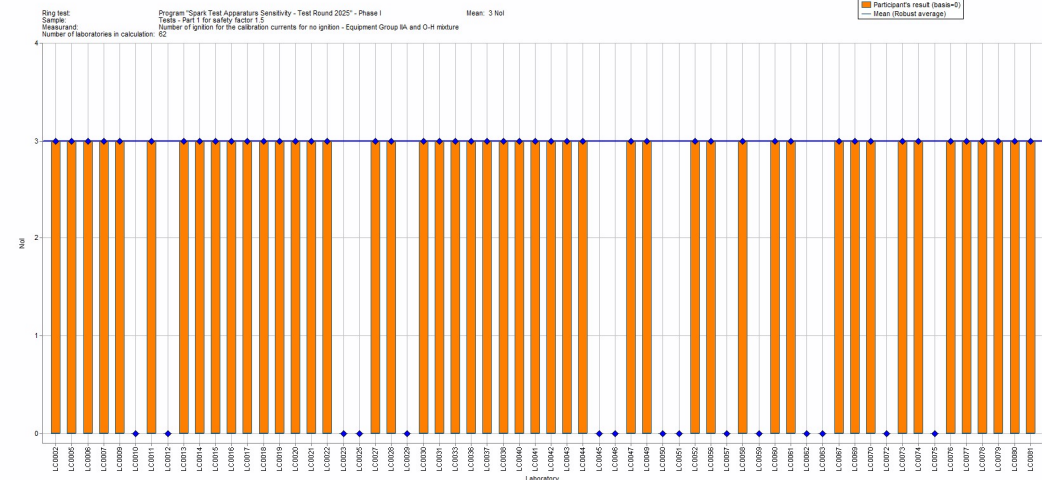
- Results of the **over-sensitivity** check according to Table 24 of IEC 60079-11:2023, Edition 7.0 – **EG IIA**



Tests with O-H-A mixture

40 out of 64 labs reported different results when testing with two gas mixtures.

Tests with O-H mixture



Self-capacitance of air-cored coil

- Self-capacitance - tests performed at PTB

$$f = \frac{1}{2 * \pi * \sqrt{L * C}}$$

where

f = resonant frequency

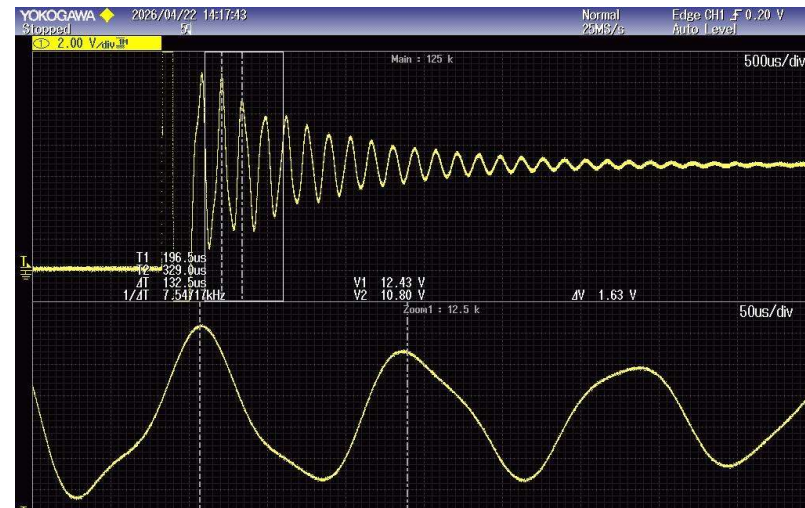
L = self-inductance of coil

C = self-capacitance of coil



L= 95.7mH, Δt=41 μs, f=24.3 kHz

Self-capacitance of coil = 445 pF



L=96 mH, Δt=132 μs, f=7.6 kHz

Self-capacitance of coil = 4602 pF



Self-capacitance of air-cored coil

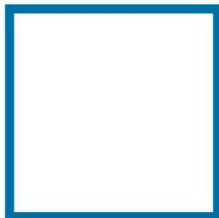
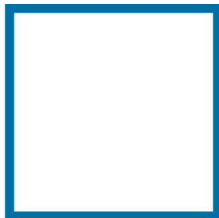
- Self-capacitance - tests performed at PTB
- Results for the sensitivity check acc. Table 23 – EG IIC

Samples	Resonant frequency in kHz	Calculated self- capacitance in pF	Number of ignitions for EG IIC acc. Table 23	Number of revolutions until ignition
Coil No. 1	7.6	4602.0	0	-
Coil No. 2	8.4	3782.7	0	-
Coil No. 3	8.9	3369.6	1	-
Coil No. 4	10.4	2467.7	5	310.6
Coil No. 5	11.0	2205.8	5	209
Test sample "STAS"	25.7	404.1	5	92.3

Five test repetitions

PTB Summary / Notes

- The sensitivity and over-sensitivity check according to Table 23 of IEC 60079-11:2023 shall be successfully passed.
- The requirements for the parameters of the STA specified in Annex B.2 of IEC 60079-11:2023 shall be met.
- For the over-sensitivity check according to Table 24 of IEC 60079-11:2023, different results may be obtained for EG I, IIA, and IIB when using the O-H-A mixture and the O-H mixture, due to their different ignitability.
- The self-capacitance of the air-cored coil used by participants should be checked to ensure that there is no significant influence on the test results, particularly for the sensitivity check acc. Table 23 – EG IIC.
- Once the program is completed, the results and findings are expected to be incorporated into the standards development process at IEC TC 31



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