

ISO 11929-4:2022-07 (E)

Determination of the characteristic limits (decision threshold, detection limit and limits of the coverage interval) for measurements of ionizing radiation - Fundamentals and application - Part 4: Guidelines to applications

Contents		Page
	Foreword.....	vii
	Introduction.....	viii
1	Scope	1
2	Normative references	2
3	Terms and definitions	2
4	Quantities and symbols	3
5	Summary of this document	5
5.1	Procedures according to ISO 11929 (all parts).....	5
5.2	Survey on the examples.....	5
5.3	General stipulations.....	8
6	Counting measurements with small or moderate uncertainties	9
6.1	Definition of the task and general aspects.....	9
6.2	Model of evaluation and standard uncertainty.....	9
6.3	Available information, input data, and specifications.....	9
6.4	Evaluation of the measurement and characteristic limits according to ISO 11929-1.....	10
6.4.1	Background effect.....	10
6.4.2	Primary result and its associated standard uncertainty.....	10
6.4.3	Standard uncertainty as a function of an assumed true value.....	10
6.4.4	Decision threshold.....	10
6.4.5	Detection limit.....	11
6.4.6	Limits of coverage intervals.....	11
6.4.7	The best estimate and its associated standard uncertainty.....	11
6.5	Documentation of the results obtained by ISO 11929-1 and ISO 11929-2.....	11
6.6	Assessment and explanations.....	13
7	Counting measurement with small count numbers	14
7.1	Definition of the task and general aspects.....	14
7.2	Model of evaluation and standard uncertainty.....	14
7.3	Available information, input data, and specifications.....	14
7.4	Evaluation of the measurement and characteristic limits according to ISO 11929-1.....	15
7.4.1	Background effect.....	15
7.4.2	Primary result and its associated standard uncertainty.....	15
7.4.3	Standard uncertainty as a function of an assumed true value.....	16
7.4.4	Decision threshold.....	16
7.4.5	Detection limit.....	16
7.4.6	Limits of coverage intervals.....	17
7.4.7	The best estimate and its associated standard uncertainty.....	17
7.5	Documentation of the results obtained by ISO 11929-1 and ISO 11929-2.....	17
7.6	Assessment and explanations.....	18
7.7	An alternative example of a measurement with small count numbers.....	19
7.7.1	General.....	19
7.7.2	Background effect.....	20
7.7.3	Primary result and its associated standard uncertainty.....	20
7.7.4	Standard uncertainty as a function of an assumed true value.....	20
7.7.5	Decision threshold.....	20
7.7.6	Detection limit.....	21
7.7.7	Limits of coverage intervals.....	21
7.7.8	The best estimate and its associated standard uncertainty.....	21
7.8	Documentation of the results obtained by ISO 11929-1 and ISO 11929-2.....	22
7.9	Assessment of the alternative example and explanations.....	23
8	Counting measurements with large uncertainties in the numerator of the calibration factor	23

8.1	Definition of the task and general aspects	23
8.2	Model of evaluation and standard uncertainty.....	24
8.3	Available information, input data, and specifications.....	24
8.4	Evaluation of the measurement and characteristic limits according to ISO 11929-1	25
8.4.1	Background effect.....	25
8.4.2	Primary result and its associated standard uncertainty.....	25
8.4.3	Standard uncertainty as a function of an assumed true value	25
8.4.4	Decision threshold.....	25
8.4.5	Detection limit.....	26
8.4.6	Limits of coverage intervals.....	26
8.4.7	The best estimate and its associated standard uncertainty.....	26
8.5	Documentation of the results obtained by ISO 11929-1 and ISO 11929-2	26
8.6	Assessment and explanations.....	28
9	Counting measurements with large uncertainties in the denominator of the calibration factor.....	28
9.1	Definition of the task and general aspects	28
9.2	Model of evaluation and standard uncertainty.....	29
9.3	Available information, input data, and specifications.....	29
9.4	Evaluation of the measurement and characteristic limits according to ISO 11929-1	30
9.4.1	Background effect.....	30
9.4.2	Primary result and its associated standard uncertainty.....	30
9.4.3	Standard uncertainty as a function of an assumed true value	31
9.4.4	Decision threshold.....	31
9.4.5	Detection limit.....	31
9.4.6	Limits of coverage intervals.....	31
9.4.7	The best estimate and its associated standard uncertainty.....	32
9.5	Documentation of the results obtained by ISO 11929-1 and ISO 11929-2	32
9.6	Assessment and explanations.....	33
10	Counting measurements with shielding of the background.....	34
10.1	Definition of the task and general aspects	34
10.2	Model of evaluation and standard uncertainty.....	34
10.3	Available information, input data, and specifications.....	34
10.4	Evaluation of the measurement and characteristic limits according to ISO 11929-1	35
10.4.1	Background effect.....	35
10.4.2	Primary result and its associated standard uncertainty.....	35
10.4.3	Standard uncertainty as a function of an assumed true value	35
10.4.4	Decision threshold.....	35
10.4.5	Detection limit.....	36
10.4.6	Limits of coverage intervals.....	36
10.4.7	The best estimate and its associated standard uncertainty.....	36
10.5	Documentation of the results obtained by ISO 11929-1 and ISO 11929-2	36
10.6	Assessment and explanations.....	38
11	Counting clearance measurement.....	38
11.1	Definition of the task and general aspects	38
11.2	Model of evaluation and standard uncertainty.....	39
11.3	Available information, input data, and specifications.....	39
11.4	Evaluation of the measurement and characteristic limits according to ISO 11929-1	40
11.4.1	Background effect.....	40
11.4.2	Primary result and its associated standard uncertainty.....	40
11.4.3	Standard uncertainty as a function of an assumed true value	40
11.4.4	Decision threshold.....	41
11.4.5	Detection limit.....	41
11.4.6	Limits of coverage intervals.....	41
11.4.7	The best estimate and its associated standard uncertainty.....	42
11.5	Documentation of the results obtained by ISO 11929-1 and ISO 11929-2	42
11.6	Assessment and explanations.....	43

12	Gamma-spectrometry of Uranium-235 with interference by Radium-226	44
12.1	Definition of the task and general aspects.....	44
12.2	Model of evaluation and standard uncertainty.....	45
12.3	Available information, input data, and specifications.....	46
12.4	Evaluation of the measurement and characteristic limits according to ISO 11929-1.....	47
12.4.1	Background effect.....	47
12.4.2	Primary result and its associated standard uncertainty.....	47
12.4.3	Standard uncertainty as a function of an assumed true value.....	48
12.4.4	Decision threshold.....	49
12.4.5	Detection limit.....	49
12.4.6	Limits of coverage intervals.....	49
12.4.7	The best estimate and its associated standard uncertainty.....	50
12.5	Documentation of the results obtained by ISO 11929-1 and ISO 11929-2.....	50
12.6	Assessment and explanations.....	51
13	Black box measurements	52
13.1	Definition of the task and general aspects.....	52
13.2	Model of evaluation and standard uncertainty.....	52
13.3	Available information, input data, and specifications.....	53
13.4	Evaluation of the measurement and characteristic limits according to ISO 11929-1.....	53
13.4.1	Background effect.....	53
13.4.2	Primary result and its associated standard uncertainty.....	54
13.4.3	Standard uncertainty as a function of an assumed true value.....	54
13.4.4	Decision threshold.....	54
13.4.5	Detection limit.....	55
13.4.6	Limits of coverage intervals.....	55
13.4.7	The best estimate and its associated standard uncertainty.....	55
13.5	Documentation of the results obtained by ISO 11929-1 and ISO 11929-2.....	56
13.6	Assessment and explanations.....	57
14	Counting measurements with unknown random influence of sample treatment	57
14.1	Definition of the task and general aspects.....	57
14.2	Model of evaluation and standard uncertainty.....	58
14.3	Available information, input data, and specifications.....	58
14.4	Evaluation of the measurement and characteristic limits according to ISO 11929-1.....	59
14.4.1	Background effect.....	59
14.4.2	Primary result and its associated standard uncertainty.....	59
14.4.3	Standard uncertainty as a function of an assumed true value.....	60
14.4.4	Decision threshold.....	60
14.4.5	Detection limit.....	61
14.4.6	Limits of coverage intervals.....	61
14.4.7	The best estimate and its associated standard uncertainty.....	61
14.5	Documentation of the results obtained by ISO 11929-1 and ISO 11929-2.....	61
14.6	Assessment and explanations.....	63
15	Counting measurement with known influence of sample treatment	63
15.1	Definition of the task and general aspects.....	63
15.2	Model of evaluation and standard uncertainty.....	64
15.3	Available information, input data, and specifications.....	65
15.4	Evaluation of the measurement and characteristic limits according to ISO 11929-1.....	66
15.4.1	Determination of the relative uncertainty of the sample treatment.....	66
15.4.2	Background effect.....	66
15.4.3	Primary result and its associated standard uncertainty.....	66
15.4.4	Standard uncertainty as a function of an assumed true value.....	67
15.4.5	Decision threshold.....	67
15.4.6	Detection limit.....	68
15.4.7	Limits of coverage intervals.....	68
15.4.8	The best estimate and its associated standard uncertainty.....	68
15.5	Documentation of the results obtained by ISO 11929-1 and ISO 11929-2.....	68
15.6	Assessment and explanations.....	70

16	Dose measurement using an active personal dosimeter	70
16.1	Definition of the task and general aspects	70
16.2	Model of evaluation and standard uncertainty.....	70
16.3	Available information, input data, and specifications.....	71
16.4	Evaluation of the measurement and characteristic limits according to ISO 11929-1	71
16.4.1	Background effect.....	71
16.4.2	Primary result and its associated standard uncertainty.....	72
16.4.3	Standard uncertainty as a function of an assumed true value	72
16.4.4	Decision threshold.....	72
16.4.5	Detection limit.....	73
16.4.6	Limits of coverage intervals.....	73
16.4.7	The best estimate and its associated standard uncertainty.....	74
16.5	Documentation of the results obtained by ISO 11929-1 and ISO 11929-2	74
16.6	Assessment and explanations.....	75
17	Dose rate measurement using a neutron area monitor	76
17.1	Definition of the task and general aspects	76
17.2	Model of evaluation and standard uncertainty.....	77
17.3	Available information, input data, and specifications.....	78
17.4	Evaluation of the measurement and characteristic limits	80
17.4.1	Background effect.....	80
17.4.2	Primary result and its associated standard uncertainty.....	80
17.4.3	Standard uncertainty as a function of an assumed true value	80
17.4.4	Decision threshold.....	81
17.4.5	Detection limit.....	82
17.4.6	Limits of coverage intervals.....	82
17.4.7	The best estimate and its associated standard uncertainty.....	83
17.5	Documentation of the results.....	83
17.6	Assessment and explanations.....	84
	Annex A (informative) Determination of a calibration factor	85
	Annex B (informative) Calculations according to ISO 11929-2	90
	Bibliography	93