

Syringe accuracy (TOGC) estimates for ISO 7886-1

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Introduction

This paper shows the method and for using table 1 in ISO 7886-1 to calculate the Tolerance on graduated capacity (TOGC) for syringes, and displays calculated values for different combinations of syringe size and expelled volume. It is available online as a pdf.

For example, if using a 1ml syringe to deliver a particular volume of expelled liquid, ISO 7886-1 states that the tolerance on the graduated capacity is

- $\pm (1.5\% \text{ syringe vol} + 2\% \text{ of the expelled volume})$ for volumes $< 0.5\text{ml}$, and
- $\pm 5\%$ of the expelled volume for volumes $\geq 0.5\text{ml}$.

Similar but different tolerances are used depending on the syringe size for syringes up to 50ml of nominal capacity.

Worked examples

As a worked example, lets look at delivering 4ml from a 10ml syringe.

- 4ml is less than half the nominal volume of a 10ml syringe so we use the first column ('less than half nominal capacity')
- $(1.5\% \times 10) + (1\% \times 4) = 0.15 + 0.04 = 0.19\text{ml}$
- As a percentage of the expelled volume (4ml), 4.75%

If instead we look at delivering an 8ml dose from a 10ml syringe:

- 8ml is greater than half the nominal volume of a 10ml syringe so we use the first column ('equal to or greater than half nominal capacity')
- $4\% \times 8 = 0.32\text{ml}$
- As a percentage of the expelled volume, 4%

Tolerance Calculation Tables

The following tables show how the error varies as the delivery volume changes for different size syringes.

The columns are as follows:

- **Syringe Size** - Nominal capacity of syringe in ml
- **Expelled Vol** - the volume intended to be delivered from the syringe in ml (the volume called 'expelled volume' in ISO 7886, although this may more accurately be called the intended volume of delivery)
- **Tolerance \pm (ml)** - Tolerance on graduated capacity (TOGC) calculated in ml as per Table 1, EN ISO 7886-1:1997

- **Tolerance \pm (%)** - Tolerance on graduated capacity calculated as a % of the Expelled Vol as per Table 1, EN ISO 7886-1:1997

The tables have been generated with the 'R'¹ language using 'R Markdown'². This document and the original Rmarkdown code are available from the SMTL website³.

¹[https://en.wikipedia.org/wiki/R_\(programming_language\)](https://en.wikipedia.org/wiki/R_(programming_language))

²<http://rmarkdown.rstudio.com/>

³<http://smtl.co.uk/pete-phillips/224-togc-from-iso-7886-1.html>

Syringe Size	Expelled Vol	Tolerance \pm (ml)	Tolerance \pm (%)
1	0.10	0.017	17.00
1	0.20	0.019	9.50
1	0.30	0.021	7.00
1	0.40	0.023	5.75
1	0.50	0.025	5.00
1	0.60	0.030	5.00
1	0.70	0.035	5.00
1	0.80	0.040	5.00
1	0.90	0.045	5.00
1	1.00	0.050	5.00

Table 1: Syringe Accuracy Vol - Syringe Size = 1 ml

Syringe Size	Expelled Vol	Tolerance \pm (ml)	Tolerance \pm (%)
2	0.10	0.032	32.00
2	0.20	0.034	17.00
2	0.30	0.036	12.00
2	0.40	0.038	9.50
2	0.50	0.040	8.00
2	0.60	0.042	7.00
2	0.70	0.044	6.29
2	0.80	0.046	5.75
2	0.90	0.048	5.33
2	1.00	0.050	5.00
2	1.10	0.055	5.00
2	1.20	0.060	5.00
2	1.30	0.065	5.00
2	1.40	0.070	5.00
2	1.50	0.075	5.00
2	1.60	0.080	5.00
2	1.70	0.085	5.00
2	1.80	0.090	5.00
2	1.90	0.095	5.00
2	2.00	0.100	5.00

Table 2: Syringe Accuracy Vol - Syringe Size = 2 ml

Syringe Size	Expelled Vol	Tolerance \pm (ml)	Tolerance \pm (%)
3	0.10	0.047	47.00
3	0.20	0.049	24.50
3	0.30	0.051	17.00
3	0.40	0.053	13.25
3	0.50	0.055	11.00
3	0.60	0.057	9.50
3	0.70	0.059	8.43
3	0.80	0.061	7.62
3	0.90	0.063	7.00
3	1.00	0.065	6.50
3	1.10	0.067	6.09
3	1.20	0.069	5.75
3	1.30	0.071	5.46
3	1.40	0.073	5.21
3	1.50	0.075	5.00
3	1.60	0.080	5.00
3	1.70	0.085	5.00
3	1.80	0.090	5.00
3	1.90	0.095	5.00
3	2.00	0.100	5.00
3	2.10	0.105	5.00
3	2.20	0.110	5.00
3	2.30	0.115	5.00
3	2.40	0.120	5.00
3	2.50	0.125	5.00
3	2.60	0.130	5.00
3	2.70	0.135	5.00
3	2.80	0.140	5.00
3	2.90	0.145	5.00
3	3.00	0.150	5.00

Table 3: Syringe Accuracy Vol - Syringe Size = 3 ml

Syringe Size	Expelled Vol	Tolerance \pm (ml)	Tolerance \pm (%)
5	0.10	0.076	76.00
5	0.20	0.077	38.50
5	0.30	0.078	26.00
5	0.40	0.079	19.75
5	0.50	0.080	16.00
5	0.60	0.081	13.50
5	0.70	0.082	11.71
5	0.80	0.083	10.37
5	0.90	0.084	9.33
5	1.00	0.085	8.50
5	1.10	0.086	7.82
5	1.20	0.087	7.25
5	1.30	0.088	6.77
5	1.40	0.089	6.36
5	1.50	0.090	6.00
5	1.60	0.091	5.69
5	1.70	0.092	5.41
5	1.80	0.093	5.17
5	1.90	0.094	4.95
5	2.00	0.095	4.75
5	2.10	0.096	4.57
5	2.20	0.097	4.41
5	2.30	0.098	4.26
5	2.40	0.099	4.12
5	2.50	0.100	4.00
5	2.60	0.104	4.00
5	2.70	0.108	4.00
5	2.80	0.112	4.00
5	2.90	0.116	4.00
5	3.00	0.120	4.00
5	3.50	0.140	4.00
5	4.00	0.160	4.00
5	4.50	0.180	4.00
5	5.00	0.200	4.00

Table 4: Syringe Accuracy Vol - Syringe Size = 5 ml

Syringe Size	Expelled Vol	Tolerance \pm (ml)	Tolerance \pm (%)
6	0.10	0.091	91.00
6	0.20	0.092	46.00
6	0.30	0.093	31.00
6	0.40	0.094	23.50
6	0.50	0.095	19.00
6	0.60	0.096	16.00
6	0.70	0.097	13.86
6	0.80	0.098	12.25
6	0.90	0.099	11.00
6	1.00	0.100	10.00
6	1.10	0.101	9.18
6	1.20	0.102	8.50
6	1.30	0.103	7.92
6	1.40	0.104	7.43
6	1.50	0.105	7.00
6	1.60	0.106	6.62
6	1.70	0.107	6.29
6	1.80	0.108	6.00
6	1.90	0.109	5.74
6	2.00	0.110	5.50
6	2.10	0.111	5.29
6	2.20	0.112	5.09
6	2.30	0.113	4.91
6	2.40	0.114	4.75
6	2.50	0.115	4.60
6	2.60	0.116	4.46
6	2.70	0.117	4.33
6	2.80	0.118	4.21
6	2.90	0.119	4.10
6	3.00	0.120	4.00
6	2.50	0.115	4.60
6	3.00	0.120	4.00
6	3.50	0.140	4.00
6	4.00	0.160	4.00
6	4.50	0.180	4.00
6	5.00	0.200	4.00
6	5.50	0.220	4.00
6	6.00	0.240	4.00

Table 5: Syringe Accuracy Vol - Syringe Size = 6 ml

Syringe Size	Expelled Vol	Tolerance \pm (ml)	Tolerance \pm (%)
10	0.10	0.151	151.00
10	0.20	0.152	76.00
10	0.30	0.153	51.00
10	0.40	0.154	38.50
10	0.50	0.155	31.00
10	0.60	0.156	26.00
10	0.70	0.157	22.43
10	0.80	0.158	19.75
10	0.90	0.159	17.67
10	1.00	0.160	16.00
10	1.50	0.165	11.00
10	2.00	0.170	8.50
10	2.50	0.175	7.00
10	3.00	0.180	6.00
10	3.50	0.185	5.29
10	4.00	0.190	4.75
10	4.50	0.195	4.33
10	5.00	0.200	4.00
10	5.50	0.220	4.00
10	6.00	0.240	4.00
10	6.50	0.260	4.00
10	7.00	0.280	4.00
10	7.50	0.300	4.00
10	8.00	0.320	4.00
10	8.50	0.340	4.00
10	9.00	0.360	4.00
10	9.50	0.380	4.00
10	10.00	0.400	4.00

Table 6: Syringe Accuracy Vol - Syringe Size = 10 ml

Syringe Size	Expelled Vol	Tolerance \pm (ml)	Tolerance \pm (%)
20	0.10	0.301	301.00
20	0.20	0.302	151.00
20	0.30	0.303	101.00
20	0.40	0.304	76.00
20	0.50	0.305	61.00
20	0.60	0.306	51.00
20	0.70	0.307	43.86
20	0.80	0.308	38.50
20	0.90	0.309	34.33
20	1.00	0.310	31.00
20	1.50	0.315	21.00
20	2.00	0.320	16.00
20	2.50	0.325	13.00
20	3.00	0.330	11.00
20	3.50	0.335	9.57
20	4.00	0.340	8.50
20	4.50	0.345	7.67
20	5.00	0.350	7.00
20	5.50	0.355	6.45
20	6.00	0.360	6.00
20	6.50	0.365	5.62
20	7.00	0.370	5.29
20	7.50	0.375	5.00
20	8.00	0.380	4.75
20	8.50	0.385	4.53
20	9.00	0.390	4.33
20	9.50	0.395	4.16
20	10.00	0.400	4.00
20	10.50	0.420	4.00
20	11.00	0.440	4.00
20	11.50	0.460	4.00
20	12.00	0.480	4.00
20	12.50	0.500	4.00
20	13.00	0.520	4.00
20	13.50	0.540	4.00
20	14.00	0.560	4.00
20	14.50	0.580	4.00
20	15.00	0.600	4.00
20	15.50	0.620	4.00
20	16.00	0.640	4.00
20	16.50	0.660	4.00
20	17.00	0.680	4.00
20	17.50	0.700	4.00
20	18.00	0.720	4.00
20	18.50	0.740	4.00
20	19.00	0.760	4.00
20	19.50	0.780	4.00
20	20.00	0.800	4.00

Table 7: Syringe Accuracy Vol - Syringe Size = 20 ml

APPENDIX A

SMTL is a UK NHS Medical Device Testing Laboratory, funded centrally to provide testing and medical device technical services to the Welsh NHS. SMTL also provides medical device testing and technical services on a commercial basis to the global medical device industry. SMTL are accredited to ISO 17025 for testing medical devices.

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