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Steel — Conversion of elongation values — Part 1: Carbon and low alloy steels

Acier — Conversion des valeurs d'allongement — Partie 1: Aciers au carbone et aciers faiblement alliés

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Foreword

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It has been approved by the member bodies of the following countries:

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The member body of the following country expressed disapproval of the document on technical grounds:

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Steel — Conversion of elongation values — Part 1: Carbon and low alloy steels

0 Introduction

Several different gauge lengths are commonly in use for the determination of percentage elongation of steels in tensile testing. Fixed gauge lengths of 50, 80, 100 and 200 mm are used; proportional gauge lengths of $k\sqrt{S_0}$ are also used for flat and round test pieces, where k may be one of a number of values, i.e. 4; 5,65; 8,16; and 11,3.

The value $5{,}65\sqrt{S_0}$ is adopted as the internationally preferred proportional gauge length.

Arising from this choice and the existence of specifications stipulating minimum percentage elongations on different gauge lengths, a growing need has been evident for an International Standard which could be used to convert test results into values based on the different gauge lengths. This part of ISO 2566 accordingly includes tables of conversion factors, tables of actual conversions for some of the most commonly used gauge lengths and elongation values, and figures which may also be used for such conversions. When using these conversions, however, note should be taken of the limitations on their applicability as stated in clause 1.

While, as indicated, the conversions are considered to be reliable within the stated limitations, because of the various factors influencing the determination of percentage elongations, they shall be used for acceptance purposes only by agreement between the customer and supplier.

In cases of dispute, the elongation shall be determined on the gauge length stated in the relevant specification.

1 Scope and field of application

This part of ISO 2566 specifies a method of converting room temperature percentage elongations after fracture obtained on various proportional and non-proportional gauge lengths to other gauge lengths.

The formula (see clause 4) on which conversions are based is considered to be reliable when applied to carbon, carbon manganese, molybdenum and chromium molybdenum steels within the tensile strength range 300 to 700 N/mm^2 and in the hot-rolled, hot-rolled and normalized or annealed conditions, with or without tempering.

These conversions are not applicable to

a) cold reduced steels;

b) quenched and tempered steels;

c) austenitic steels.

Neither should they be used where the gauge length exceeds $25\sqrt{S_0}$ or where the width to thickness ratio of the test piece exceeds 20.

Care should be exercised in the case of strip under 4 mm thickness, as the index in the formula given in clause 4 increases with decreasing thickness; the value to be used shall be the subject of agreement between the customer and the supplier.

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2 Symbols

In this part of ISO 2566, the symbols shown in table 1 are used.

Table 1 — List of symbols

Symbol	Description
A	Percentage elongation on gauge length, L_0, after fracture, obtained on test
A_r	Percentage elongation on a different gauge length, required by conversion
d	Diameter of test piece
L_0	Original gauge length
S_0	Original cross-sectional area of test piece

3 Definitions

For the purpose of this part of ISO 2566, the following definitions apply:

3.1 gauge length: Any length of the parallel portion of the test piece used for measurement of strain.

The term is hereafter used in this part of ISO 2566 to denote the original gauge length, L_0, marked on the test piece for the determination of percentage elongation after fracture, A.

3.2 proportional gauge length: A gauge length having a specified relation to the square root of the cross-sectional area, for example $5{,}65\sqrt{S_0}$.

3.3 non-proportional gauge length: A gauge length not specifically related to the cross-sectional area of the test piece, usually expressed in a given dimension, for example 50 mm.

4 Basic formula

The data contained in this part of ISO 2566 are based on the Oliver formula,[1] which is now widely used for such elongation conversions.

The Oliver formula can, in a simplified form, be expressed as

$$A_r = 1{,}74A\left(\frac{\sqrt{S_0}}{L_0}\right)^{0{,}4}$$

where

A_r is the required elongation on gauge length L_0;

A is the elongation on a gauge length of $4\sqrt{S_0}$;

S_0 and L_0 are defined in table 1.

This formula gives a direct conversion of elongation on $4\sqrt{S_0}$ to the equivalent for a test piece of cross-sectional area S_0, and a gauge length L_0. Expressed in terms of $5{,}65\sqrt{S_0}$, which is now regarded as the internationally accepted standard gauge length, it becomes

$$A_r = 2A\left(\frac{\sqrt{S_0}}{L_0}\right)^{0{,}4}$$

where A is the elongation on a gauge length of $5{,}65\sqrt{S_0}$.

Tables 2 to 22 and figures 1 to 5 have been prepared on the basis of the above formulae.

5 Conversion from one proportional gauge length to another proportional gauge length

Simple multiplying factors based on the formula are used for such conversions, and the relationships between a number of the more widely used proportional gauge lengths are given in table 2. Detailed conversions of elongations obtained on $4\sqrt{S_0}$ to $5{,}65\sqrt{S_0}$ are given in table 6.

6 Conversion from one non-proportional gauge length to another non-proportional gauge length for test pieces of equal cross-sectional area

The conversion of elongation values of different fixed gauge lengths on test pieces of equal cross-sectional area are also made by simple factors. Conversion factors for gauge lengths of 50, 80, 100 and 200 mm are given in table 3.

7 Conversion from a proportional gauge length to a non-proportional gauge length

The conversion factors are variable according to the cross-sectional area of the non-proportional test piece. Table 4 gives the multiplying factors for conversion from elongation on $5{,}65\sqrt{S_0}$ to the equivalent on fixed gauge lengths of 50, 80, 100 and 200 mm for a range of cross-sectional areas. For conversions in the reverse direction, i.e. elongation on a fixed gauge length to the equivalent of $5{,}65\sqrt{S_0}$, the reciprocal of the factors is used.

Examples:

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a) Elongation of 20 % on $5{,}65\sqrt{S_0}$ is equivalent to $20 \times 1{,}139 = 22{,}78$ % on a 25 mm wide test piece of 6 mm thickness with a 50 mm gauge length (see table 4);

b) Elongation of 25 % on a 40 mm × 10 mm test piece of 200 mm gauge length is equivalent to $25 \times 1/0{,}796 = 31{,}4$ % on $5{,}65\sqrt{S_0}$ (see table 4).

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From the examples shown it will be seen that conversions involving other proportional gauge lengths can be obtained by prior or subsequent use of the factors shown in table 2.

Tables 7 to 10 can be used to obtain some of these conversions, whilst tables 15 to 18 can be used to obtain elongations on fixed gauge lengths corresponding to $5{,}65\sqrt{S_0}$.

Similarly, tables 11 to 14 can be used for conversion to $4\sqrt{S_0}$ and tables 19 to 22 for elongations on fixed gauge lengths corresponding to $4\sqrt{S_0}$.

8 Conversion from a non-proportional gauge length to another non-proportional gauge length for test pieces of different cross-sectional areas

It is preferable for this calculation to be made in two stages with an initial conversion to $5{,}65\sqrt{S_0}$.

1) OLIVER, D.A. *Proc. Inst. Mech. Eng.*, **11** 1928: 827.

Example:

Elongation of 24 % on 200 mm for a 40 mm × 15 mm test piece in terms of equivalent on a 30 mm × 10 mm test piece with gauge lengths equal to 200, 100 and 50 mm.

24 × 1/0,863 = 27,8 % on $5{,}65\sqrt{S_0}$ (see table 4).

27,8 × 0,752 = 20,9 % on 30 mm × 10 mm with 200 mm gauge length

27,8 × 0,992 = 27,6 % on 30 mm × 10 mm with 100 mm gauge length

27,8 × 1,309 = 36,4 % on 30 mm × 10 mm with 50 mm gauge length

Elongation on other proportional gauge lengths can be obtained by using the factors given in table 2.

9 Use of figures 1 to 5

9.1 Figures 1 to 5 may be used as an alternative quick method to obtain elongation conversions.

9.2 Figures 1 to 4 may be used for conversions between $5{,}65\sqrt{S_0}$ and 50 mm, $5{,}65\sqrt{S_0}$ and 200 mm, $4\sqrt{S_0}$ and 50 mm and $4\sqrt{S_0}$ and 200 mm gauge lengths, respectively.

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Example:

To find the equivalent elongation on $5{,}65\sqrt{S_0}$ and $4\sqrt{S_0}$ to an elongation of 21 % on a 200 mm gauge length of a 25 mm × 12,5 mm test piece of cross-sectional area 312,5 mm².

The intersection of this ordinate with the abscissa representing an elongation of 21 % on a 200 mm gauge length lies on the sloping line representing an elongation of 28 % on $5{,}65\sqrt{S_0}$ on figure 2 and at a position relative to the sloping lines on figure 4 approximating to an elongation of 32,2 on $4\sqrt{S_0}$.

9.3 Figure 5 may be used for the calculation of all elongation conversions.

The Oliver formula may be rewritten as

$$A_2 = A_1\left(\frac{K_1}{K_2}\right)^{0,4}$$

$$= \lambda_{1;2} \times A_1$$

where K_1 and K_2 designate the proportionality ratios of any two test pieces.

$$K_1 = \frac{L_1}{\sqrt{S_1}}$$

$$K_2 = \frac{L_2}{\sqrt{S_2}}$$

Figure 5 shows the values of $\lambda_{1;2} = (K_1/K_2)^{0,4}$.

To use figure 5 it is necessary to perform the following operations:

a) calculate the values of proportionality $K_1 = (L_1/\sqrt{S_1})$ and $K_2 = (L_2/\sqrt{S_2})$ for two test pieces;

b) read graphically the coefficient $\lambda_{1;2} = (K_1/K_2)^{0,4}$;

c) the elongation obtained is $A_2 = \lambda_{1;2} \times A_1$.

Table 2 — Conversion factors: Proportional gauge lengths

Conversion from:	Factor for conversion to:						
	$4\sqrt{S_0}$	$5{,}65\sqrt{S_0}$	$8{,}16\sqrt{S_0}$	$11{,}3\sqrt{S_0}$	$4d$	$5d$	$8d$
$4\sqrt{S_0}$	1,000	0,870	0,752	0,661	0,953	0,870	0,721
$5{,}65\sqrt{S_0}$	1,149	1,000	0,863	0,759	1,093	1,000	0,828
$8{,}16\sqrt{S_0}$	1,330	1,158	1,000	0,879	1,268	1,158	0,960
$11{,}3\sqrt{S_0}$	1,514	1,317	1,137	1,000	1,443	1,317	1,091
$4d$	1,050	0,916	0,790	0,694	1,000	0,916	0,758
$5d$	1,149	1,000	0,863	0,759	1,093	1,000	0,828
$8d$	1,389	1,207	1,042	0,918	1,319	1,207	1,000

Table 3 — Conversion factors[1]: Non-proportional gauge lengths

Conversion from:	Factor for conversion to:			
	50 mm	80 mm	100 mm	200 mm
50 mm	1,000	0,829	0,758	0,754
80 mm	1,207	1,000	0,915	0,693
100 mm	1,320	1,093	1,000	0,758
200 mm	1,741	1,443	1,320	1,000

1) Provided cross-sectional areas are the same.

Table 4 — Conversion factors from 5,65$\sqrt{S_0}$ to non-proportional gauge lengths

Factors shown under "non-proportional gauge lengths" give the value of

$$2\left(\frac{\sqrt{S_0}}{L}\right)^{0,4}$$

To convert from values on a gauge length of 5,65$\sqrt{S_0}$ to a non-proportional gauge length, multiply by the appropriate factor.

To convert from values on a non-proportional gauge length to 5,65$\sqrt{S_0}$, divide by the appropriate factor.

See also figures 1 and 2.

Cross-sectional area of test piece	Factor for non-proportional gauge length of:			
mm²	200 mm	100 mm	80 mm	50 mm
5	0,331	0,437	0,478	0,577
10	0,381	0,502	0,549	0,663
15	0,413	0,545	0,596	0,719
20	0,437	0,577	0,631	0,761
25	0,457	0,603	0,660	0.796
30	0,474	0,626	0,684	0,826
35	0,489	0,645	0,706	0,852
40	0,502	0,663	0,725	0,875
45	0,514	0,679	0,742	0,896
50	0,525	0,693	0,758	0,915
55	0,535	0,706	0,772	0,932
60	0,545	0,719	0,786	0,949
70	0,562	0,741	0,811	0,978
80	0,577	0,761	0,833	1,005
90	0,591	0,780	0,852	1,029
100	0,603	0,796	0,871	1,051
110	0,615	0,812	0,887	1,071
120	0,626	0,826	0,903	1,090
130	0,636	0,839	0,917	1,107
140	0,645	0,852	0,931	1,124
150	0,654	0,863	0,944	1,139
160	0,663	0,875	0,956	1,154
170	0,671	0,885	0,968	1,168
180	0,679	0,896	0,979	1,182
190	0,686	0,905	0,990	1,195
200	0,693	0,915	1,000	1,207
210	0,700	0,924	1,010	1,219
220	0,706	0,932	1,019	1,230
230	0,713	0,941	1,028	1,241
240	0,719	0,949	1,037	1,252
250	0,725	0,956	1,046	1,262
260	0,730	0,964	1,054	1,272
270	0,736	0,971	1,062	1,281
280	0,741	0,978	1,070	1,291
290	0,747	0,985	1,077	1,300
300	0,752	0,992	1,084	1,309
310	0,757	0,998	1,092	1,317
320	0,761	1,005	1,099	1,326
330	0,766	1,011	1,105	1,334
340	0,771	1,017	1,112	1,342
350	0,775	1,023	1,118	1,350
360	0,780	1,029	1,125	1,357
370	0,784	1,034	1,131	1,365
380	0,788	1,040	1,137	1,372
390	0,792	1,045	1,143	1,379

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Table 4 *(concluded)* — **Conversion factors from $5{,}65\sqrt{S_0}$ to non-proportional gauge lengths**

Cross-sectional area of test piece	Factor for non-proportional gauge length of:			
mm²	200 mm	100 mm	80 mm	50 mm
400	0,796	1,051	1,149	1,386
410	0,800	1,056	1,154	1,393
420	0,804	1,061	1,160	1,400
430	0,808	1,066	1,165	1,406
440	0,812	1,071	1,171	1,413
450	0,815	1,076	1,176	1,419
460	0,819	1,080	1,181	1,426
470	0,822	1,085	1,186	1,432
480	0,826	1,090	1,191	1,438
490	0,829	1,094	1,196	1,444
500	0,833	1,099	1,201	1,450
550	0,849	1,120	1,224	1,477
600	0,863	1,139	1,246	1,503
650	0,877	1,158	1,266	1,528
700	0,891	1,175	1,285	1,550
750	0,903	1,191	1,303	1,572
800	0,915	1,207	1,320	1,592
850	0,926	1,222	1,336	1,612
900	0,936	1,236	1,351	1,630
950	0,947	1,249	1,366	1,648
1 000	0,956	1,262	1,380	1,665
1 050	0,966	1,274	1,393	1,681
1 100	0,975	1,286	1,406	1,697
1 150	0,983	1,298	1,419	1,712
1 200	0,992	1,309	1,431	1,727
1 250	1,000	1,320	1,443	1,741
1 300	1,008	1,330	1,454	1,755
1 350	1,016	1,340	1,465	1,768
1 400	1,023	1,350	1,476	1,781
1 450	1,030	1,359	1,486	1,794
1 500	1,037	1,369	1,496	1,806
1 550	1,044	1,378	1,506	1,818
1 600	1,051	1,386	1,516	1,829
1 650	1,057	1,395	1,525	1,841
1 700	1,063	1,403	1,534	1,852
1 750	1,070	1,411	1,543	1,862
1 800	1,076	1,419	1,552	1,873
1 850	1,082	1,427	1,560	1,883
1 900	1,087	1,435	1,569	1,893
1 950	1,093	1,442	1,577	1,903
2 000	1,099	1,450	1,585	1,913
2 050	1,104	1,457	1,593	1,922
2 100	1,109	1,464	1,600	1,931
2 150	1,115	1,471	1,608	1,941
2 200	1,120	1,477	1,615	1,950
2 250	1,125	1,484	1,623	1,958
2 300	1,130	1,491	1,630	1,967
2 350	1,135	1,497	1,637	1,975
2 400	1,139	1,503	1,644	1,984
2 450	1,144	1,510	1,651	1,992
2 500	1,149	1,516	1,657	2,000
2 550	1,153	1,522	1,664	2,008
2 600	1,158	1,528	1,670	2,016
2 650	1,162	1,533	1,677	2,023
2 700	1,167	1,539	1,683	2,031
2 750	1,171	1,545	1,689	2,038
2 800	1,175	1,550	1,695	2,046
2 850	1,179	1,556	1,701	2,053
2 900	1,183	1,561	1,707	2,060
2 950	1,187	1,567	1,713	2,067
3 000	1,191	1,572	1,719	2,074

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Table 5 — Conversion factors from $4\sqrt{S_0}$ to non-proportional gauge lengths

Factors shown under "non-proportional gauge lengths" give the value of

$$1{,}74\left(\frac{\sqrt{S_0}}{L}\right)^{0{,}4}$$

To convert from values on a gauge length of $4\sqrt{S_0}$ to a non-proportional gauge length, multiply by the appropriate factor.

To convert from values on a non-proportional gauge length to $4\sqrt{S_0}$, divide by the appropriate factor.

See also figures 3 and 4.

Cross-sectional area of test piece	Factor for non-proportional gauge length of:			
mm²	200 mm	100 mm	80 mm	50 mm
5	0,288	0,380	0,416	0,502
10	0,331	0,437	0,478	0,577
15	0,359	0,474	0,518	0,625
20	0,380	0,502	0,549	0,662
25	0,398	0,525	0,574	0,693
30	0,413	0,544	0,595	0,718
35	0,426	0,562	0,614	0,741
40	0,437	0,577	0,631	0,761
45	0,447	0,590	0,646	0,779
50	0,457	0,603	0,659	0,796
55	0,466	0,615	0,672	0,811
60	0,474	0,626	0,684	0,825
70	0,489	0,645	0,705	0,851
80	0,502	0,662	0,724	0,874
90	0,514	0,678	0,742	0,895
100	0,525	0,693	0,757	0,914
110	0,535	0,706	0,772	0,932
120	0,544	0,718	0,786	0,948
130	0,553	0,730	0,798	0,963
140	0,562	0,741	0,810	0,978
150	0,560	0,751	0,821	0,991
160	0,577	0,761	0,832	1,004
170	0,584	0,770	0,842	1,016
180	0,590	0,779	0,852	1,028
190	0,597	0,788	0,861	1,039
200	0,603	0,796	0,870	1,050
210	0,609	0,804	0,879	1,060
220	0,615	0,811	0,887	1,070
230	0,620	0,818	0,895	1,080
240	0,625	0,825	0,902	1,089
250	0,631	0,832	0,910	1,098
260	0,636	0,839	0,917	1,107
270	0,640	0,845	0,924	1,115
280	0,645	0,851	0,931	1,123
290	0,650	0,857	0,937	1,131
300	0,654	0,863	0,943	1,139
310	0,658	0,869	0,950	1,146
320	0,662	0,874	0,956	1,153
330	0,667	0,880	0,962	1,161
340	0,671	0,885	0,967	1,168
350	0,674	0,890	0,973	1,174
360	0,678	0,895	0,979	1,181
370	0,682	0,900	0,984	1,187
380	0,686	0,905	0,989	1,194
390	0,689	0,909	0,994	1,200

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Table 5 *(concluded)* — Conversion factors from $4\sqrt{S_0}$ to non-proportional gauge lengths

Cross-sectional area of test piece	Factor for non-proportional gauge length of:			
mm²	200 mm	100 mm	80 mm	50 mm
400	0,693	0,914	0,999	1,206
410	0,696	0,919	1,004	1,212
420	0,699	0,923	1,009	1,218
430	0,703	0,927	1,014	1,224
440	0,706	0,932	1,019	1,229
450	0,709	0,936	1,023	1,235
460	0,712	0,940	1,028	1,240
470	0,715	0,944	1,032	1,246
480	0,718	0,948	1,036	1,251
490	0,721	0,952	1,041	1,256
500	0,724	0,956	1,045	1,261
550	0,738	0,974	1,065	1,285
600	0,751	0,991	1,084	1,308
650	0,763	1,007	1,101	1,329
700	0,775	1,022	1,118	1,349
750	0,786	1,036	1,133	1,368
800	0,796	1,050	1,148	1,385
850	0,805	1,063	1,162	1,402
900	0,815	1,075	1,175	1,418
950	0,824	1,087	1,188	1,434
1 000	0,832	1,098	1,200	1,449
1 050	0,840	1,109	1,212	1,463
1 100	0,848	1,119	1,223	1,477
1 150	0,856	1,129	1,234	1,490
1 200	0,863	1,139	1,245	1,502
1 250	0,870	1,148	1,255	1,515
1 300	0,877	1,157	1,265	1,527
1 350	0,883	1,166	1,275	1,538
1 400	0,890	1,174	1,284	1,549
1 450	0,896	1,183	1,293	1,560
1 500	0,902	1,191	1,302	1,571
1 550	0,908	1,198	1,310	1,581
1 600	0,914	1,206	1,319	1,591
1 650	0,920	1,214	1,327	1,601
1 700	0,925	1,221	1,335	1,611
1 750	0,931	1,228	1,343	1,620
1 800	0,936	1,235	1,350	1,629
1 850	0,941	1,242	1,358	1,638
1 900	0,946	1,248	1,365	1,647
1 950	0,951	1,255	1,372	1,656
2 000	0,956	1,261	1,379	1,664
2 050	0,960	1,267	1,386	1,672
2 100	0,965	1,273	1,392	1,680
2 150	0,970	1,279	1,399	1,688
2 200	0,974	1,285	1,405	1,696
2 250	0,979	1,291	1,412	1,704
2 300	0,983	1,297	1,418	1,711
2 350	0,987	1,302	1,424	1,719
2 400	0,991	1,308	1,430	1,726
2 450	0,995	1,313	1,436	1,733
2 500	0,999	1,319	1,442	1,740
2 550	1,003	1,324	1,448	1,747
2 600	1,007	1,329	1,453	1,754
2 650	1,011	1,334	1,459	1,760
2 700	1,015	1,339	1,464	1,767
2 750	1,019	1,344	1,470	1,773
2 800	1,022	1,349	1,475	1,780
2 850	1,026	1,354	1,480	1,786
2 900	1,029	1,358	1,485	1,792
2 950	1,033	1,363	1,490	1,799
3 000	1,036	1,368	1,495	1,805

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Table 6 — Elongation values[1)] on $5{,}65 \sqrt{S_0}$ corresponding to those obtained on $4 \sqrt{S_0}$ gauge length

Actual elongation (%) measured on $4 \sqrt{S_0}$	0	1	2	3	4	5	6	7	8	9
	Corresponding elongation (%) on $5{,}65 \sqrt{S_0}$									
10	9	10	10	11	12	13	14	15	16	17
20	17	18	19	20	21	22	23	23	24	25
30	26	27	28	29	30	30	31	32	33	34
40	35	36	37	37	38	39	40	41	42	43
50	43	44	45	46	47	48	49	50	50	51

1) Factor 0,87. Values rounded to nearest whole number.

Table 7 — Elongation values[1)] on $5{,}65 \sqrt{S_0}$ corresponding to those obtained on 50 mm gauge length

Actual elongation (%) on 50 mm gauge length	Corresponding elongation (%) on $5{,}65 \sqrt{S_0}$ gauge length if cross-sectional area in square millimetres is:																				
	5	10	20	40	60	80	100	150	200	250	300	400	500	600	700	800	900	1 000	1 200	1 500	2 000	2 500
18	31	27	24	21	19	18	17	16	15	14	14	13	12	12	12	11	11	11	10	10	9	9
19	33	29	25	22	20	19	18	17	16	15	15	14	13	13	12	12	12	11	11	11	10	10
20	35	30	26	23	21	20	19	18	17	16	15	14	14	13	13	13	12	12	12	11	10	10
21	36	32	28	24	22	21	20	18	17	17	16	15	14	14	14	13	13	13	12	12	11	11
22	38	33	29	25	23	22	21	19	18	17	17	16	15	15	14	14	13	13	13	12	12	11
23	40	35	30	26	24	23	22	20	19	18	18	17	16	15	15	14	14	14	13	13	12	12
24	42	36	32	27	25	24	23	21	20	19	18	17	17	16	15	15	15	14	14	13	13	12
25	43	38	33	29	26	25	24	22	21	20	19	18	17	17	16	16	15	15	14	14	13	13
26	45	39	34	30	27	26	25	23	22	21	20	19	18	17	17	16	16	16	15	14	14	13
27	47	41	35	31	28	27	26	24	22	21	21	19	19	18	17	17	17	16	16	15	14	14
28	49	42	37	32	30	28	27	25	23	22	21	20	19	19	18	18	17	17	16	16	15	14
29	50	44	38	33	31	29	28	25	24	23	22	21	20	19	19	18	18	17	17	16	15	15
30	52	45	39	34	32	30	29	26	25	24	23	22	21	20	19	19	18	18	17	17	16	15
31	54	47	41	35	33	31	30	27	26	25	24	22	21	21	20	19	19	19	18	17	16	16
32	55	48	42	37	34	32	30	28	27	25	24	23	22	21	21	20	20	19	19	18	17	16
33	57	50	43	38	35	33	31	29	27	26	25	24	23	22	21	21	20	20	19	18	17	17
34	59	51	45	39	36	34	32	30	28	27	26	25	23	23	22	21	21	20	20	19	18	17
35	61	53	46	40	37	35	33	31	29	28	27	25	24	23	23	22	21	21	20	19	18	18
36	62	54	47	41	38	36	34	32	30	29	28	26	25	24	23	23	22	22	21	20	19	18
37	64	56	49	42	39	37	35	32	31	29	28	27	26	25	24	23	23	22	21	20	19	19
38	66	57	50	43	40	38	36	33	31	30	29	27	26	25	25	24	23	23	22	21	20	19
39	68	59	51	45	41	39	37	34	32	31	30	28	27	26	25	24	24	23	23	22	20	20
40	69	60	53	46	42	40	38	35	33	32	31	29	28	27	26	25	25	24	23	22	21	20
41	71	62	54	47	43	41	39	36	34	32	31	30	28	27	26	26	25	25	24	23	21	21
42	73	63	55	48	44	42	40	37	35	33	32	30	29	28	27	26	26	25	24	23	22	21
43	75	65	56	49	45	43	41	38	36	34	33	31	30	29	28	27	26	26	25	24	22	22
44	76	66	58	50	46	44	42	39	36	35	34	32	30	29	28	28	27	26	25	24	23	22
45	78	68	59	51	47	45	43	39	37	36	34	32	31	30	29	28	28	27	26	25	24	23
46	80	69	60	53	48	46	44	40	38	36	35	33	32	31	30	29	28	28	27	25	24	23
47	81	71	62	54	50	47	45	41	39	37	36	34	32	31	30	30	29	28	27	26	25	24

1) Rounded to the nearest whole number.

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Table 8 — Elongation values[1] on $5,65\sqrt{S_0}$ corresponding to those obtained on 80 mm gauge length

Actual elongation (%) on 80 mm gauge length	Corresponding elongation (%) on $5,65\sqrt{S_0}$ gauge length if cross-sectional area in square millimetres is:																					
	5	10	20	40	60	80	100	150	200	250	300	400	500	600	700	800	900	1 000	1 200	1 500	2 000	2 500
10	21	18	16	14	13	12	11	11	10	10	9	9	8	8	8	8	7	7	7	7	6	6
11	23	20	17	15	14	13	13	12	11	11	10	10	9	9	9	8	8	8	8	7	7	7
12	25	22	19	17	15	14	14	13	12	11	11	10	10	10	9	9	9	9	8	8	8	7
13	27	24	21	18	17	16	15	14	13	12	12	11	11	10	10	10	10	9	9	9	8	8
14	29	25	22	19	18	17	16	15	14	13	13	12	12	11	11	11	10	10	10	9	9	8
15	31	27	24	21	19	18	17	16	15	14	14	13	12	12	12	11	11	11	10	10	9	9
16	33	29	25	22	20	19	18	17	16	15	15	14	13	13	12	12	12	12	11	11	10	10
17	36	31	27	23	22	20	20	18	17	16	16	15	14	14	13	13	13	12	12	11	11	10
18	38	33	29	25	23	22	21	19	18	17	17	16	15	14	14	14	13	13	13	12	11	11
19	40	35	30	26	24	23	22	20	19	18	18	17	16	15	15	14	14	14	13	13	12	11
20	42	36	32	28	25	24	23	21	20	19	18	17	17	16	16	15	15	14	14	13	13	12
21	44	38	33	29	27	25	24	22	21	20	19	18	17	17	16	16	16	15	15	14	13	13
22	46	40	35	30	28	26	25	23	22	21	20	19	18	18	17	17	16	16	15	15	14	13
23	48	42	36	32	29	28	26	24	23	22	21	20	19	18	18	17	17	17	16	15	15	14
24	50	44	38	33	31	29	28	25	24	23	22	21	20	19	19	18	18	17	17	16	15	14
25	52	46	40	34	32	30	29	26	25	24	23	22	21	20	19	19	19	18	17	17	16	15
26	54	47	41	36	33	31	30	28	26	25	24	23	22	21	20	20	19	19	18	17	16	16
27	56	49	43	37	34	32	31	29	27	26	25	24	22	22	21	20	20	20	19	18	17	16
28	59	51	44	39	36	34	32	30	28	27	26	24	23	22	22	21	21	20	20	19	18	17
29	61	53	46	40	37	35	33	31	29	28	27	25	24	23	23	22	21	21	20	19	18	17
30	63	55	48	41	38	36	34	32	30	29	28	26	25	24	23	23	22	22	21	20	19	18
31	65	56	49	43	39	37	36	33	31	30	29	27	26	25	24	23	23	22	22	21	20	19
32	67	58	51	44	41	38	37	34	32	31	30	28	27	26	25	24	24	23	22	21	20	19
33	69	60	52	46	42	40	38	35	33	32	30	29	27	26	26	25	24	24	23	22	21	20
34	71	62	54	47	43	41	39	36	34	33	31	30	28	27	26	26	25	25	24	23	21	21
35	73	64	55	48	45	42	40	37	35	33	32	30	29	28	27	27	26	25	24	23	22	21
36	75	66	57	50	46	43	41	38	36	34	33	31	30	29	28	27	27	26	25	24	23	22
37	77	67	59	51	47	44	43	39	37	35	34	32	31	30	29	28	27	27	26	25	23	22
38	79	69	60	52	48	46	44	40	38	36	35	33	32	31	30	29	28	28	27	25	24	23
39	82	71	62	54	50	47	45	41	39	37	36	34	32	31	30	30	29	28	27	26	25	24
40	84	73	63	55	51	48	46	42	40	38	37	35	33	32	31	30	30	29	28	27	25	24
41	86	75	65	57	52	49	47	43	41	39	38	36	34	33	32	31	30	30	29	27	26	25
42	88	76	67	58	53	50	48	44	42	40	39	37	35	34	33	32	31	30	29	28	27	25
43	90	78	68	59	55	52	49	46	43	41	40	37	36	35	33	33	32	31	30	29	27	26
44	92	80	70	61	56	53	51	47	44	42	41	38	37	35	34	33	33	32	31	29	28	27
45	94	82	71	62	57	54	52	48	45	43	41	39	37	36	35	34	33	33	31	30	28	27
46	96	84	73	63	59	55	53	49	46	44	42	40	38	37	36	35	34	33	32	31	29	28
47	98	86	74	65	60	56	54	50	47	45	43	41	39	38	37	36	35	34	33	31	30	28

1) Rounded to the nearest whole number.

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Table 9 — Elongation values[1)] on $5,65\sqrt{S_0}$ corresponding to those obtained on 100 mm gauge length

Actual elongation (%) on 100 mm gauge length	Corresponding elongation (%) on $5,65\sqrt{S_0}$ gauge length if cross-sectional area in square millimetres is:																				
	5	10	20	40	60	80	100	150	200	250	300	400	500	600	700	800	900	1 000	1 200	1 500	2 000	2 500
18	41	36	31	27	25	24	23	21	20	19	18	17	16	16	15	15	15	14	14	13	12	12
19	43	38	33	29	26	25	24	22	21	20	19	18	17	17	16	16	15	15	15	14	13	13
20	46	40	35	30	28	26	25	23	22	21	20	19	18	18	17	17	16	16	15	15	14	13
21	48	42	36	32	29	28	26	24	23	22	21	20	19	18	18	17	17	17	16	15	14	14
22	50	44	38	33	31	29	28	25	24	23	22	21	20	19	19	18	18	17	17	16	15	15
23	53	46	40	35	32	30	29	27	25	24	23	22	21	20	20	19	19	18	18	17	16	15
24	55	48	42	36	33	32	30	28	26	25	24	23	22	21	20	20	19	19	18	18	17	16
25	57	50	43	38	35	33	31	29	27	26	25	24	23	22	21	21	20	20	19	18	17	16
26	59	52	45	39	36	34	33	30	28	27	26	25	24	23	22	22	21	21	20	19	18	17
27	62	54	47	41	38	35	34	31	30	28	27	26	25	24	23	22	22	21	21	20	19	18
28	64	56	49	42	39	37	35	32	31	29	28	27	25	25	24	23	23	22	21	20	19	18
29	66	58	50	44	40	38	36	34	32	30	29	28	26	25	25	24	23	23	22	21	20	19
30	69	60	52	45	42	39	38	35	33	31	30	29	27	26	26	25	24	24	23	22	21	20
31	71	62	54	47	43	41	39	36	34	32	31	30	28	27	26	26	25	25	24	23	21	20
32	73	64	55	48	45	42	40	37	35	33	32	30	29	28	27	27	26	25	24	23	22	21
33	75	66	57	50	46	43	41	38	36	35	33	31	30	29	28	27	27	26	25	24	23	22
34	78	68	59	51	47	45	43	39	37	36	34	32	31	30	29	28	28	27	26	25	23	22
35	80	70	61	53	49	46	44	41	38	37	35	33	32	31	30	29	28	28	27	26	24	23
36	82	72	62	54	50	47	45	42	39	38	36	34	33	32	31	30	29	29	28	26	25	24
37	85	74	64	56	51	49	46	43	40	39	37	35	34	32	31	31	30	29	28	27	26	24
38	87	76	66	57	53	50	48	44	42	40	38	36	35	33	32	31	31	30	29	28	26	25
39	89	78	68	59	54	51	49	45	43	41	39	37	36	34	33	32	32	31	30	28	27	26
40	91	80	69	60	56	53	50	46	44	42	40	38	36	35	34	33	32	32	31	29	28	26
41	94	82	71	62	57	54	51	47	45	43	41	39	37	36	35	34	33	32	31	30	28	27
42	96	84	73	63	58	55	53	49	46	44	42	40	38	37	36	35	34	33	32	31	29	28
43	98	86	75	65	60	56	54	50	47	45	43	41	39	38	37	36	35	34	33	31	30	28
44	101	88	76	66	61	58	55	51	48	46	44	42	40	39	37	36	36	35	34	32	30	29
45	103	90	78	68	63	59	57	52	49	47	45	43	41	39	38	37	36	36	34	33	31	30
46	105	92	80	69	64	60	58	53	50	48	46	44	42	40	39	38	37	36	35	34	32	30
47	107	94	81	71	65	62	59	54	51	49	47	45	43	41	40	39	38	37	36	34	32	31

1) Rounded to the nearest whole number.

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