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Jekla - Pretvarjanje vrednosti raztezkov - 2. del: Avstenitna jekla (ISO 2566-2:1984)

Steel - Conversion of elongation values - Part 2: Austenitic steels (ISO 2566-2:1984)

Stahl - Umrechnung von Bruchdehnungswerten - Teil 2: Austenitische Stähle (ISO 2566-2:1984)

Acier - Conversion des valeurs d'allongement - Partie 2: Aciers austénitiques (ISO 2566-2:1984)

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EUROPEAN STANDARD
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English version

Steel - Conversion of elongation values - Part 2: Austenitic steels (ISO 2566-2:1984)

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Austenitische Stähle (ISO 2566-2:1984)

This European Standard was approved by CEN on 25 April 1999.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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International Standard



2566/2

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

**Steel — Conversion of elongation values —
Part 2: Austenitic steels**

Acier — Conversion des valeurs d'allongement — Partie 2: Aciers austénitiques

First edition — 1984-08-01

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been authorized has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

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International Standard ISO 2566/2 was developed by Technical Committee ISO/TC 17, *Steel*, and was circulated to the member bodies in April 1983.

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

Australia	Hungary	Poland
Austria	India	Romania
Belgium	Iran	South Africa, Rep. of
Bulgaria	Italy	Spain
Canada	Kenya	Tanzania
China	Korea, Dem. P. Rep. of	Thailand
Czechoslovakia	Korea, Rep. of	Turkey
Finland	Mexico	United Kingdom
France	Netherlands	USSR
Germany, F.R.	Norway	

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

Sweden

Steel — Conversion of elongation values — Part 2: Austenitic 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 austenitic stainless steels within the tensile strength range 450 to 750 N/mm² and in the solution treated condition.

These conversions are not applicable to

- cold reduced steels;
- quenched and tempered steels;
- non-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 3 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.

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 .

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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 a formula obtained from a statistical assessment of international test results, which, in a simplified form, can be expressed as

$$A_r = 1,25A \left(\frac{\sqrt{S_0}}{L_0} \right)^{0,127}$$

where

A_r is the required elongation on gauge length L_0 ;

A is the elongation on a gauge length of $5,65\sqrt{S_0}$ which is the internationally accepted gauge length;

S_0 and L_0 are defined in table 1.

Expressed in terms of $4\sqrt{S_0}$ the formula becomes

$$A_r = 1,19A \left(\frac{\sqrt{S_0}}{L_0} \right)^{0,127}$$

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

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.

Example:

Elongation of 20 % on $5,65\sqrt{S_0}$ is equivalent to $20 \times 1,046 = 20,9$ % on a 25 mm wide test piece of 6 mm thickness with a 50 mm gauge length (see table 4).

From the example 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 $5,65\sqrt{S_0}$.

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.

$$24 \times 1/0,957 = 25,1 \text{ % on } 5,65\sqrt{S_0} \text{ (see table 4)}$$

$$25,1 \times 0,916 = 23,0 \text{ % on } 30 \text{ mm} \times 10 \text{ mm with } 200 \text{ mm gauge length}$$

$$25,1 \times 1,000 = 25,1 \text{ % on } 30 \text{ mm} \times 10 \text{ mm with } 100 \text{ mm gauge length}$$

$$25,1 \times 1,093 = 27,4 \text{ % on } 30 \text{ mm} \times 10 \text{ mm with } 50 \text{ mm gauge length}$$

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.

Example:

To find the equivalent elongation on $5,65\sqrt{S_0}$ and $4\sqrt{S_0}$ to an elongation of 25 % on a 200 mm gauge length of a $25\text{ mm} \times 12,5\text{ mm}$ test piece of cross-sectional area $312,5\text{ mm}^2$.

The intersection of this ordinate with the abscissa representing an elongation of 25 % on a 200 mm gauge length lies on the sloping line representing an elongation of 27,2 % 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 28,8 % on $4\sqrt{S_0}$.

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

The formula given in clause 4 may be rewritten as

$$A_2 = A_1 \left(\frac{K_1}{K_2} \right)^{0,127}$$

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

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 $\lambda_{1,2} = (K_1/K_2)^{0,127}$.

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

- calculate the value of proportionality $K_1 = (L_1/\sqrt{S_1})$ and $(K_2 = L_2/\sqrt{S_2})$ for two test pieces;
- read graphically the coefficient $\lambda_{1,2} = (K_1/K_2)^{0,127}$;
- the elongation obtained is $A_2 = \lambda_{1,2} \times A_1$.

Example:

Elongation of 24 % on 200 mm for a $40\text{ mm} \times 15\text{ mm}$ test piece in terms of equivalent on a $30\text{ mm} \times 10\text{ mm}$ test piece with a gauge length equal to 100 mm.

$$a) K_1 = \frac{L_1}{\sqrt{S_1}} = \frac{200}{\sqrt{600}} = 8,16$$

$$K_2 = \frac{L_2}{\sqrt{S_2}} = \frac{100}{\sqrt{300}} = 5,77$$

b) From figure 5, $\lambda_{1,2} = 1,04$.

c) Elongation required is $24 \times 1,04 = 25,0\%$.

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	0,957	0,913	0,876	0,985	0,957	0,902
$5,65\sqrt{S_0}$	1,045	1,000	0,954	0,916	1,029	1,000	0,942
$8,16\sqrt{S_0}$	1,095	1,048	1,000	0,959	1,078	1,048	0,987
$11,3\sqrt{S_0}$	1,141	1,092	1,042	1,000	1,124	1,092	1,029
$4d$	1,015	0,972	0,928	0,890	1,000	0,972	0,916
$5d$	1,045	1,000	0,954	0,916	1,029	1,000	0,942
$8d$	1,109	1,061	1,013	0,972	1,092	1,062	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	0,942	0,916	0,839
80 mm	1,062	1,000	0,972	0,890
100 mm	1,092	1,029	1,000	0,916
200 mm	1,193	1,123	1,092	1,000

1) Provided cross-sectional areas are the same.

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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

$$1,25 \left(\frac{\sqrt{S_0}}{L_0} \right)^{0,127}$$

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:			
	200 mm	100 mm	80 mm	50 mm
5	0,706	0,771	0,794	0,842
10	0,738	0,806	0,829	0,880
15	0,757	0,827	0,851	0,903
20	0,771	0,842	0,867	0,920
25	0,782	0,854	0,879	0,933
30	0,792	0,864	0,889	0,944
35	0,779	0,873	0,898	0,953
40	0,806	0,880	0,906	0,961
45	0,812	0,887	0,912	0,969
50	0,818	0,893	0,919	0,975
55	0,823	0,898	0,924	0,981
60	0,827	0,903	0,929	0,986
70	0,835	0,912	0,938	0,996
80	0,842	0,920	0,946	1,005
90	0,849	0,927	0,953	1,012
100	0,854	0,933	0,960	1,019
110	0,860	0,939	0,966	1,025
120	0,864	0,944	0,971	1,031
130	0,869	0,949	0,976	1,036
140	0,873	0,953	0,981	1,041
150	0,877	0,957	0,985	1,045
160	0,880	0,961	0,989	1,050
170	0,884	0,965	0,993	1,054
180	0,887	0,969	0,996	1,058
190	0,890	0,972	1,000	1,061
200	0,893	0,975	1,003	1,065
210	0,896	0,978	1,006	1,068
220	0,898	0,981	1,009	1,071
230	0,901	0,984	1,012	1,074
240	0,903	0,986	1,015	1,077
250	0,906	0,989	1,017	1,080
260	0,908	0,991	1,020	1,083
270	0,910	0,994	1,022	1,085
280	0,912	0,996	1,025	1,088
290	0,914	0,998	1,027	1,090
300	0,916	1,000	1,029	1,093
310	0,918	1,003	1,031	1,095
320	0,920	1,005	1,033	1,097
330	0,922	1,007	1,035	1,099
340	0,923	1,008	1,037	1,101
350	0,925	1,010	1,039	1,103
360	0,927	1,012	1,041	1,105
370	0,928	1,014	1,043	1,107
380	0,930	1,016	1,045	1,109
390	0,932	1,017	1,047	1,111

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:			
	mm ²	200 mm	100 mm	80 mm
400	0,933	1,019	1,048	1,113
410	0,935	1,021	1,050	1,114
420	0,936	1,022	1,051	1,116
430	0,937	1,024	1,053	1,118
440	0,939	1,025	1,055	1,119
450	0,940	1,027	1,056	1,121
460	0,941	1,028	1,058	1,123
470	0,943	1,029	1,059	1,124
480	0,944	1,031	1,060	1,126
490	0,945	1,032	1,062	1,127
500	0,946	1,033	1,063	1,129
550	0,952	1,040	1,070	1,135
600	0,957	1,045	1,076	1,142
650	0,962	1,051	1,081	1,148
700	0,967	1,056	1,086	1,153
750	0,971	1,060	1,091	1,158
800	0,975	1,065	1,095	1,163
850	0,979	1,069	1,100	1,167
900	0,982	1,073	1,104	1,171
950	0,986	1,076	1,107	1,176
1 000	0,989	1,080	1,111	1,179
1 050	0,992	1,083	1,114	1,183
1 100	0,995	1,087	1,118	1,187
1 150	0,998	1,090	1,121	1,190
1 200	1,000	1,093	1,124	1,193
1 250	1,003	1,095	1,127	1,196
1 300	1,006	1,098	1,130	1,199
1 350	1,008	1,101	1,132	1,202
1 400	1,010	1,103	1,135	1,205
1 450	1,013	1,106	1,138	1,208
1 500	1,015	1,108	1,140	1,210
1 550	1,017	1,110	1,142	1,213
1 600	1,019	1,113	1,145	1,215
1 650	1,021	1,115	1,147	1,217
1 700	1,023	1,117	1,149	1,220
1 750	1,025	1,119	1,151	1,222
1 800	1,027	1,121	1,153	1,224
1 850	1,028	1,123	1,155	1,226
1 900	1,030	1,125	1,157	1,228
1 950	1,032	1,127	1,159	1,230
2 000	1,033	1,129	1,161	1,232
2 050	1,035	1,130	1,163	1,234
2 100	1,037	1,132	1,165	1,236
2 150	1,038	1,134	1,166	1,238
2 200	1,040	1,135	1,168	1,240
2 250	1,041	1,137	1,170	1,242
2 300	1,043	1,139	1,171	1,243
2 350	1,044	1,140	1,173	1,245
2 400	1,045	1,142	1,175	1,247
2 450	1,047	1,143	1,176	1,248
2 500	1,048	1,145	1,178	1,250
2 550	1,050	1,146	1,179	1,252
2 600	1,051	1,148	1,181	1,253
2 650	1,052	1,149	1,182	1,255
2 700	1,053	1,150	1,183	1,256
2 750	1,055	1,152	1,185	1,258
2 800	1,056	1,153	1,186	1,259
2 850	1,057	1,154	1,187	1,260
2 900	1,058	1,156	1,189	1,262
2 950	1,059	1,157	1,190	1,263
3 000	1,060	1,158	1,191	1,265

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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

$$1,19 \left(\frac{\sqrt{S_0}}{L_0} \right)^{0,127}$$

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:			
	200 mm	100 mm	80 mm	50 mm
5	0,673	0,734	0,756	0,802
10	0,703	0,767	0,790	0,838
15	0,721	0,787	0,810	0,860
20	0,734	0,802	0,825	0,876
25	0,745	0,813	0,837	0,888
30	0,754	0,823	0,847	0,899
35	0,761	0,831	0,855	0,907
40	0,767	0,838	0,862	0,915
45	0,773	0,844	0,869	0,922
50	0,778	0,850	0,874	0,928
55	0,783	0,855	0,880	0,934
60	0,787	0,860	0,885	0,939
70	0,795	0,868	0,893	0,948
80	0,802	0,876	0,901	0,956
90	0,808	0,882	0,908	0,964
100	0,813	0,888	0,914	0,970
110	0,818	0,894	0,919	0,976
120	0,823	0,899	0,924	0,981
130	0,827	0,903	0,929	0,986
140	0,831	0,907	0,934	0,991
150	0,835	0,911	0,938	0,995
160	0,838	0,915	0,941	0,999
170	0,841	0,919	0,945	1,003
180	0,844	0,922	0,949	1,007
190	0,847	0,925	0,952	1,010
200	0,850	0,928	0,955	1,014
210	0,853	0,931	0,958	1,017
220	0,855	0,934	0,961	1,020
230	0,858	0,937	0,963	1,023
240	0,860	0,939	0,966	1,025
250	0,862	0,941	0,969	1,028
260	0,864	0,944	0,971	1,031
270	0,866	0,946	0,973	1,033
280	0,868	0,948	0,976	1,036
290	0,870	0,950	0,978	1,038
300	0,872	0,952	0,980	1,040
310	0,874	0,954	0,982	1,042
320	0,876	0,956	0,984	1,044
330	0,877	0,958	0,986	1,046
340	0,879	0,960	0,988	1,048
350	0,881	0,962	0,989	1,050
360	0,882	0,964	0,991	1,052
370	0,884	0,965	0,993	1,054
380	0,885	0,967	0,995	1,056
390	0,887	0,968	0,996	1,058