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Steel — Conversion of elongation values —

Part 2: Austenitic steels

Acier — Conversion des valeurs d'allongement —

Partie 2: Aciers austénitiques

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 20, *General technical delivery conditions, sampling and mechanical testing methods,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 459/SC 1, *Test methods for steel (other than chemical analysis),* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 2566-2:1984), of which it constitutes a minor revision. The changes are as follows:

— complete editorial revision;

— Tables 2 to 5 have been renamed due to reordering in order to follow the logical flow of information of this document;

— Clause 9 has been restructured into four sub-clauses in order to follow the logical flow of information of this document.

A list of all parts in the ISO 2566 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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 mm, 80 mm, 100 mm 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 or 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 that could be used to convert test results into values based on the different gauge lengths. Accordingly, this document 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.

Steel — Conversion of elongation values —

Part 2: Austenitic steels

1 Scope

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

Formula (1), 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/mm^2 and in the solution treated condition.

These conversions are not applicable to:

a) cold reduced steels;

b) quenched and tempered steels;

c) non-austenitic steels.

These conversions are not applicable when the gauge length exceeds $25\sqrt{S_0}$ or where the width to thickness ratio of the test piece exceeds 20.

2 Normative references

There are no normative references in this document.

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1.1
gauge length
length of the parallel portion of the test piece used for measurement of strain

Note 1 to entry: The term is hereafter used in this document to denote the original gauge length, L_0, marked on the test piece for the determination of percentage elongation after fracture, A.

3.1.2
proportional gauge length
gauge length (3.1.1) having a specified relation to the square root of the cross-sectional area, for example $5{,}65\sqrt{S_0}$

3.1.3
non-proportional gauge length
gauge length (3.1.1) not specifically related to the cross-sectional area of the test piece, usually expressed in a given dimension, for example 50 mm

3.2 Symbols

A	Percentage elongation after fracture on a gauge length, 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

4 Basic formula

The data contained in this document are based on a formula obtained from a statistical assessment of international test results, which, in a simplified form, can be expressed as Formula (1):

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

where

A_r is the required elongation on gauge length L_0;

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

L_0 is the original gauge length;

S_0 is the original cross-sectional area of test piece.

Expressed in terms of $4\sqrt{S_0}$, Formula (1) becomes Formula (2):

$$A_r = 1{,}19A\left(\frac{\sqrt{S_0}}{L_0}\right)^{0{,}127} \quad (2)$$

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

Tables 1 to 21 and Figures 1 to 5 are based on Formulae (1) and (2).

Care should be exercised in the case of strip under 3 mm thickness, as the index in Formulae (1) and (2) increases with decreasing thickness; the value to be used shall be the subject of agreement between the customer and the supplier.

5 Requirements on conversions

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.

6 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 1. Detailed conversions of elongations obtained on $4\sqrt{S_0}$ to $5{,}65\sqrt{S_0}$ are given in Table 2.

Table 1 — Conversion factors: Proportional gauge length

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	0,931	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	1,987
$11{,}3\sqrt{S_0}$	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 2 — Elongation values[a] on $5{,}65\sqrt{S_0}$ corresponding to those obtained on $4\sqrt{S_0}$ gauge length

Actual elongation (%) measured on $4\sqrt{S_0}$	Corresponding elongation (%) on $5{,}65\sqrt{S_0}$									
	0	1	2	3	4	5	6	7	8	9
10	10	11	11	12	13	14	15	16	17	18
20	19	20	21	22	23	24	25	26	27	28
30	29	30	31	32	33	33	34	35	36	37
40	38	39	40	41	42	43	44	45	46	47
50	48	49	50	51	52	53	54	55	56	56

[a] Factor 0,957. Values rounded to nearest whole number.

7 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.

Table 3 — Conversion factors[a]: Non-proportional gauge length

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

[a] Provided cross-sectional areas are the same.

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 x 15 mm test piece in terms of equivalent on a 30 mm x 10 mm test piece with gauge lengths equal to 200 mm, 100 mm and 50 mm.

24 x 1/0,957 = 25,1 % on $5{,}65\sqrt{S_0}$ (see Table 3)

25,1 x 0,916 = 23,0 % on 30 mm x 10 mm with 200 mm gauge length

25,1 x 1,000 = 25,1 % on 30 mm x 10 mm with 100 mm gauge length

25,1 x 1,093 = 27,4 % on 30 mm x 10 mm with 50 mm gauge length

Elongation on other proportional gauge lengths can be obtained by using the factors given in Table 1.

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

9.1 General

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 mm, 80 mm, 100 mm 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 x 1,046 = 20,9 % on a 25 mm wide test piece of 6 mm thickness with a 50 mm gauge length (see Table 3).

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 1.

9.2 Conversion factors from $5{,}65\sqrt{S_0}$ to non-proportional gauge length

Factors shown under “non-proportional gauge length” give the value of

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

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.

Table 4 — 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	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

Table 4 *(continued)*

Cross sectional area of test piece:	Factor for non-proportional gauge length of:			
mm^2	200 mm	100 mm	80 mm	50 mm
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
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