标准下载站
anystandards.com

DIN EN ISO 18265

DIN

ICS 77.040.10

Supersedes DIN 50150,
October 2000 edition.

Metallic materials

Conversion of hardness values
(ISO 18265 : 2003)
English version of DIN EN ISO 18265

Metallische Werkstoffe – Umwertung von Härtewerten (ISO 18265 : 2003)

European Standard EN ISO 18265 : 2003 has the status of a DIN Standard.

A comma is used as the decimal marker.

National foreword

This standard has been published in accordance with a decision taken by ECISS/TC 1 to adopt, without alteration, International Standard ISO 18265 as a European Standard.

The responsible German body involved in its preparation was the *Normenausschuss Materialprüfung* (Materials Testing Standards Committee), Technical Committee *Härteprüfung für Metalle.*

Amendments

DIN 50150, October 2000 edition, has been superseded by the specifications of ISO 18265, which is identical to ISO 18265.

Previous editions

DIN 50150: 1957-05, 1976-12, 2000-10.

Document comprises 74 pages.

© No part of this standard may be reproduced without the prior permission of *DIN Deutsches Institut für Normung e. V.*, Berlin. *Beuth Verlag GmbH*, 10772 Berlin, Germany, has the exclusive right of sale for German Standards *(DIN-Normen)*.

English price group 23
www.din.de
www.beuth.de

06.04 9557423

标准下载站
anystandards.com

标准下载站
anystandards.com

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN ISO 18265

November 2003

ICS 77.040.01

English version

Metallic materials

Conversion of hardness values
(ISO 18265 : 2003)

Matériaux métalliques – Conversion des valeur de dureté (ISO 18265 : 2003)

Metallische Werkstoffe – Umwertung von Härtewerten (ISO 18265 : 2003)

This European Standard was approved by CEN on 2003-10-03.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Management Centre or to any CEN member.

The European Standards exist in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, the Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland, and the United Kingdom.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Management Centre: rue de Stassart 36, B-1050 Brussels

© 2003. CEN – All rights of exploitation in any form and by any means reserved worldwide for CEN national members.

Ref. No. EN ISO 18265 : 2003 E

标准下载站
anystandards.com

Foreword

International Standard

ISO 18265 : 2003 Metallic materials – Conversion of hardness values,

which was prepared by ISO/TC 164 'Mechanical testing of metals' of the International Organization for Standardization, has been adopted by Technical Committee ECISS/TC 1 'Steels – Mechanical and physical tests', the Secretariat of which is held by AFNOR, as a European Standard.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, and conflicting national standards withdrawn, by May 2004 at the latest.

In accordance with the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard:

Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, the Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland, and the United Kingdom.

Endorsement notice

The text of the International Standard ISO 18265 : 2003 was approved by CEN as a European Standard without any modification.

NOTE: Normative references to international publications are listed in Annex ZA (normative).

Contents

Page

标准下载站
anystandards.com

Introduction

The hardness conversion values given in Table A.1 were obtained in interlaboratory tests by the *Verein Deutscher Eisenhüttenleute* (VDEh) (German Iron and Steel Institute) using verified and calibrated hardness testing machines. Statistically reliable information cannot be given on the uncertainty of these values because the test conditions were not reproducible, and the number of results used to calculate the mean hardness values is not known. The conversion values in Table A.1 are in accordance with the information presented in IC No. 3 (1980) and IC No. 4 (1982) of the European Coal and Steel Community, as well as in ISO 4964:1984 and ISO/TR 10108:1989.

Annexes C, D and E contain — in a revised format — the extensive results on the conversion of hardness values presented in TGL 43212/02 to 43212/04, standards published by the former East German standards body, the *Amt für Standardisierung, Meßwesen und Warenprüfung* (ASMW). The values presented in Annex B had also been determined by the ASMW, but were published in a report of the *Physikalisch-Technische Bundesanstalt* (PTB) [1], the German national institute for science and technology, not in a TGL standard.

The converted hardness values in the above-mentioned TGL standards were obtained in statistically reliable hardness and tensile tests. The hardness tests were performed using ASMW normal testing machines on plane-parallel, polished specimens of various materials in different heat treatment conditions. Tensile strength was tested on machines whose force measuring and extension measuring systems had been calibrated immediately before testing. The tensile test method used is equivalent to that specified in ISO 6892, and the calibration procedures conform with those specified in ISO 7500-1 and ISO 9513.

Users of this International Standard should take note of Clause 3, especially the concluding warning.

标准下载站
anystandards.com

1 Scope

This International Standard specifies the principles of the conversion of hardness values and gives general information on the use of conversion tables.

The conversion tables in Annexes A to F apply to

— unalloyed and low-alloy steels and cast iron;

— steels for quenching and tempering;

— cold working steels;

— high speed steels;

— hardmetals;

— non-ferrous metals and alloys.

NOTE The conversion tables in Annexes B to E are based on empirical results which were evaluated by means of regression analysis. Such analysis was not possible in the case of the values given in Annex A because a sufficient number of results was not available.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 6506-1:1999, *Metallic materials — Brinell hardness test — Part 1: Test method*

ISO 6507-1:1997, *Metallic materials — Vickers hardness test — Part 1: Test method*

ISO 6507-2:1997, *Metallic materials — Vickers hardness test — Part 2: Verification of testing machines*

ISO 6508-1:1999, *Metallic materials — Rockwell hardness test — Part 1: Test method (scales A, B, C, D, E, F, G, H, K, N, T)*

ISO 6508-2:1999, *Metallic materials — Rockwell hardness test — Part 2: Verification and calibration of testing machines (scales A, B, C, D, E, F, G, H, K, N, T)*

ISO 6892:1998, *Metallic materials — Tensile testing at ambient temperature*

ISO 7500-1:—[1)], *Metallic materials — Verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Verification and calibration of the force-measuring system*

ISO 9513:1999, *Metallic materials — Calibration of extensometers used in uniaxial testing*

---

1) To be published. (Revision of ISO 7500-1:1999)

标准下载站
anystandards.com

3 Principles of conversion

Hardness testing is a form of materials testing that provides information on the mechanical properties of a material with limited destruction of the specimen and within a relatively short period of time. In practice, it is often desirable to use hardness results to draw conclusions on the tensile strength of the same material if tensile testing is too involved or the piece to be examined is not to be destroyed.

Since the means of loading in hardness testing is considerably different from that in tensile testing, it is not possible to derive a reliable functional relationship between these two characteristic values on the basis of a model. Nevertheless, hardness values and tensile strength values are positively correlated, and so it is possible to draw up empirical relationships for limited applications.

Often it is necessary to check a given hardness value against a value gained by a different test method. This is especially the case if only a certain method can be used due to the particular specimen or coating thickness, the size of the object to be tested, surface quality, or the availability of hardness testing machines.

Conversion of hardness values to tensile values makes it possible to carry out hardness measurement in place of the measurement of tensile strength taking into account that these tensile strength values must be seen as being the least reliable form of conversion. Likewise, with conversion between hardness scales, a hardness value can be replaced with a value obtained using the desired method.

NOTE Sometimes a conversion relationship is drawn on a single-case basis to gain information on properties other than hardness, most often to obtain a good estimate of tensile strength. Special relationships are sometimes also drawn for hardness-to-hardness conversions. This may be done as long as the following conditions are fulfilled.

— The hardness test method is only used internally, and the results obtained not be compared with those of other methods, or the details of the test procedure are defined precisely enough so that results can be reproduced by another laboratory or at another time.

— The conversion tables used have been derived from a sufficiently large number of parallel experiments using both scales and carried out on the material in question.

— Complaints may not be made on the basis of converted values.

— Converted results are expressed in such a manner that it is clear which method was used to determine the original hardness value.

WARNING — In practice, an attempt is often made to establish a strong relationship between the original and converted values without taking into consideration the characteristics of the material under test. As Figures 1 and 2 show, this is not possible. Therefore, users of this International Standard should ensure that all conditions for conversion are met (see also [2] and [3]).

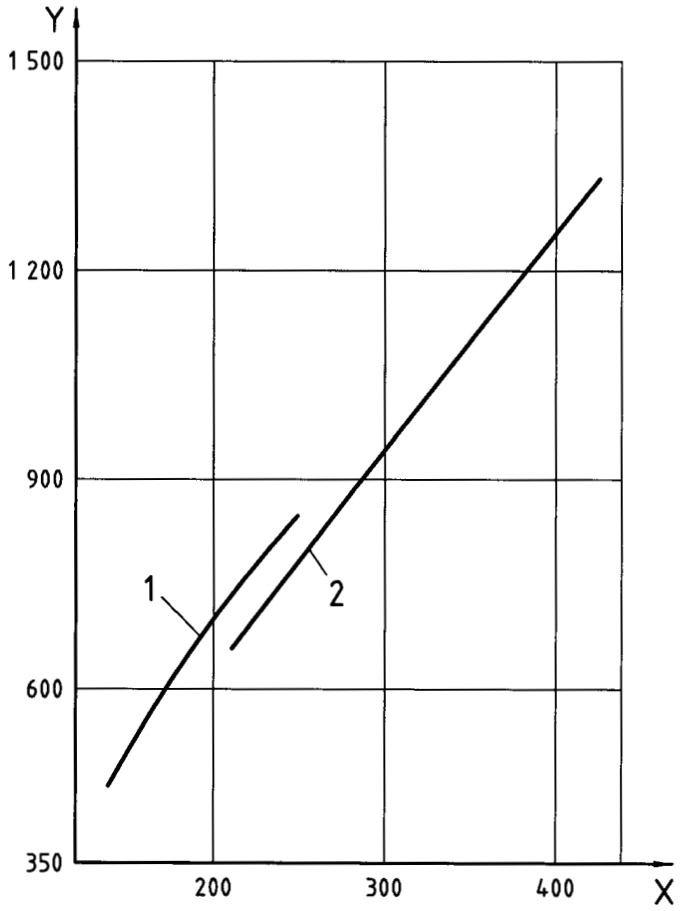
4 Application of conversion tables

4.1 General

Conversion from one hardness value to another, or from a hardness value to a tensile strength value, involves uncertainties which must be taken into account. Extensive investigations have shown that it is not possible to establish universally applicable conversion relationships between hardness values obtained by different methods, no matter how carefully the tests had been carried out. This lies in the fact that there is a complex relationship between the indentation behaviour of a material and its elasticity. For this reason, the given conversion relationship provides greater equivalence the more similarity there is between the elasticity of the tested material and that of the material used to establish the relationship. Likewise, a better equivalence can be expected for methods with similar indentation processes (i.e. where the differences in the force application-indentation procedures and the test parameters is minimal). Therefore, conversion from hardness values to tensile values must be seen as being the least reliable form of conversion.

NOTE In many cases, the yield strength or the 0,2 % proof strength provides information on the elastic behaviour of a material.

标准下载站
anystandards.com



X Hardness, HV 30

Y Tensile strength, R_m, MPa

Key

1 untreated, soft annealed, normalized

2 quenched and tempered

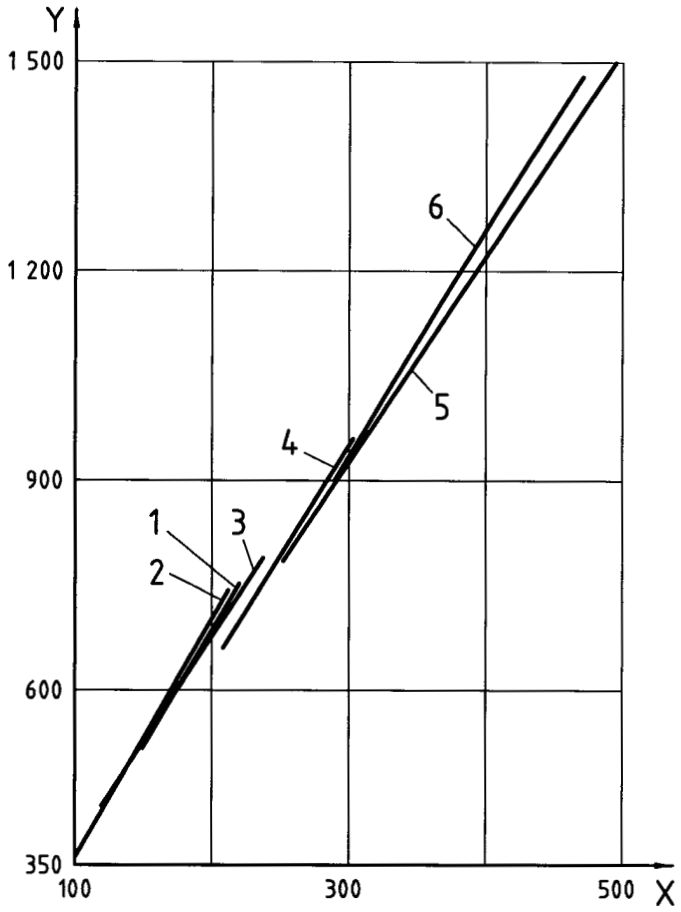
Figure 1 —HV 30/R_m curves for quenching and tempering steels in various heat treatment conditions

It should be noted that each hardness determination is only applicable to the immediate area of the indentation. Where hardness varies, e.g. at an increasing distance from the surface, Brinell or Vickers hardness values, or even tensile strength values can deviate from the converted values solely as a result of the different rate of elongation within the area under consideration.

Hardness values should only be converted when the prescribed test method cannot be used, e.g. because a suitable machine is not available, or if the required samples cannot be taken. A suitable test method can be selected with the aid of Figures 3 and 4. Values obtained by conversion may only be taken as the basis of complaints if so agreed in the delivery contract.

If hardness or tensile strength values are determined by conversion in accordance with this International Standard, this shall be stated, as shall the hardness test method used (see ISO 6506-1, ISO 6507-1, ISO 6508-1).

标准下载站
anystandards.com



X Hardness, HV 30

Y Tensile strength, R_m, MPa

Key

1 R_e/R_m = 0,45 to 0,59

2 R_e/R_m = 0,60 to 0,69

3 R_e/R_m = 0,70 to 0,79 normal annealed

4 R_e/R_m = 0,70 to 0,79 heat treated

5 R_e/R_m = 0,80 to 0,89

6 R_e/R_m = 0,90 to 0,99

Figure 2 — Mean HV 30/R_m curves for quenching and tempering steels with different R_e/R_m ratios

The basis of conversion shall be the mean of at least three individual hardness values.

To ensure an acceptable uncertainty of measurement, the specimen surfaces shall be machine-finished.

The uncertainties of the values given in the conversion tables here comprise the confidence interval of the hardness conversion curves calculated by means of regression analysis, and the uncertainty of the hardness or tensile strength value to be converted. The confidence interval of the regression function is a parameter that cannot be influenced by the user and is calculated as a function of hardness.

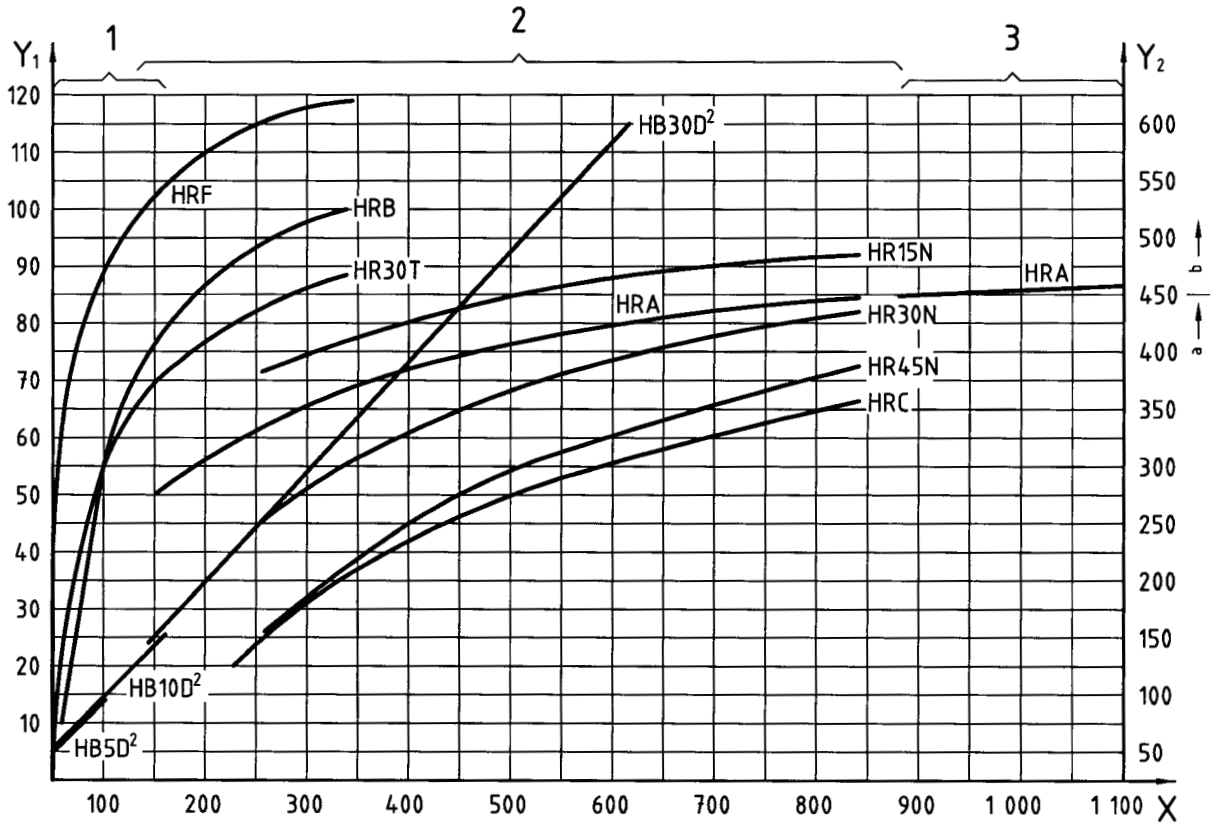
The uncertainty associated with the hardness values to be converted is influenced by the repeatability of the testing machine, the quality of the specimen surface, the uniformity of the specimen's hardness and the number of indentations used to determine hardness. It is thus dependent on the test conditions of the person doing the conversion. This conversion is to be carried out on the basis of the tables given in this International Standard for various groups of materials. These tables give hardness values for various scales and, in some cases, the relevant tensile strength.

When only comparing the values in these tables without actually carrying out hardness testing, the uncertainty of the converted value is reduced to the confidence interval of the calculated hardness conversion curve.

标准下载站
anystandards.com

When using the tables, it is not significant which value is taken as the measured value and which as the converted one.

The determination of the uncertainty of converted values, as well as the specification of a permissible level of uncertainty may be agreed upon, in which case the converted values are to be established on the basis of the mean of five individual values.



X Vicker hardness, HV 30

Y_1 Rockwell hardness

Y_2 Brinell hardness

Key

1 non-ferrous metal

2 steel

3 hardmetal

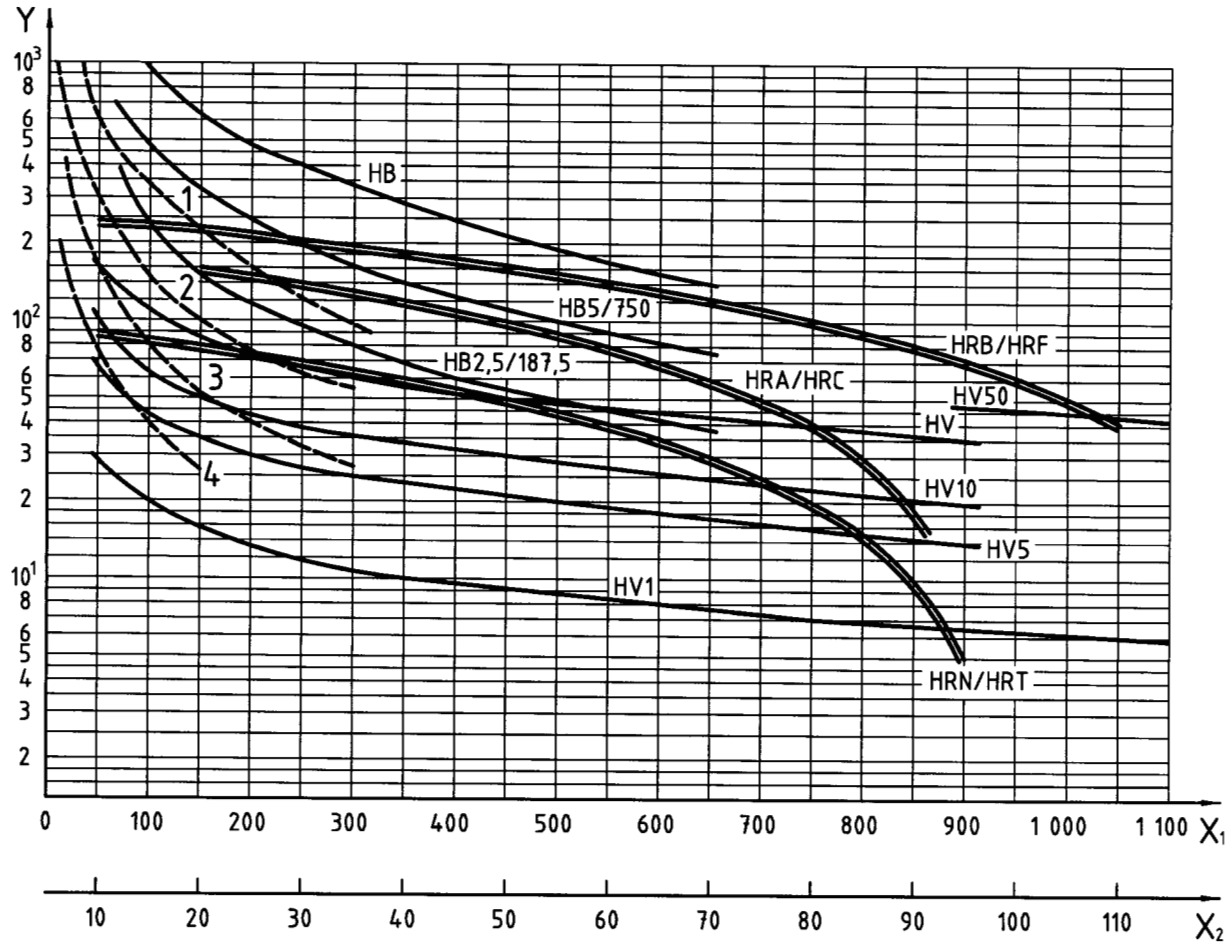
NOTE This figure is intended only as an aid in selecting an alternative test method and is not to be used for conversion purposes.

[a] Determined with a steel ball (HBS).

[b] Determined with a hardmetal ball (HBW).

Figure 3 — Various hardness scales compared to the Vickers scale

标准下载站
anystandards.com



X_1 Brinell hardness/Vicker hardness

X_2 Rockwell hardness, (according to its different scales)

Y Indentation depth, µm

Key

1 HB10/1 000

2 HB10/500 and HB 5/250

3 HB5/125 and HB 2,5/62,5

4 HB2,5/62,5

Figure 4 — Indentation depth as a function of hardness for various test methods

4.2 Converting values

4.2.1 Limits of error

Depending on the measurement conditions in practice, measured value/converted value pairs (e.g. HV/HRC, HRC/HV, HRA/HRN, HB/R_m) can be taken from the tables in Annexes B to F. Essential criteria which should be taken into account when selecting a hardness test method are discussed in this clause.

The example below illustrates the conversion of values together with their limits of error using Table C.2.

Given hardness value: (300 ± 30) HV

Desired scale: HRC

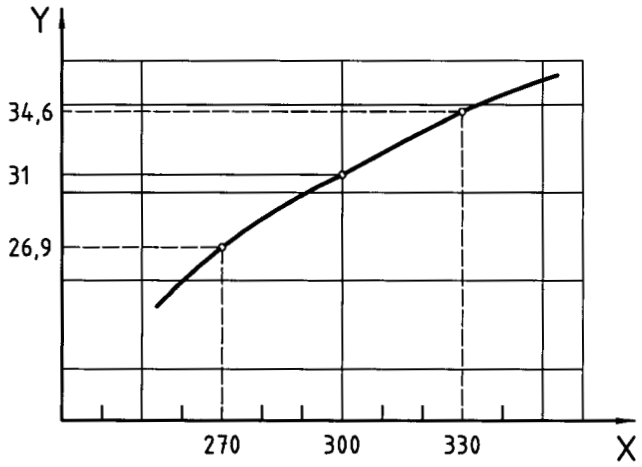
标准下载站
anystandards.com

Converted values from table: 270 HV ≙ 26,9 HRC

300 HV ≙ 31,0 HRC

330 HV ≙ 34,6 HRC

The converted value, $31\ ^{+3,6}_{-4,1}$ HRC, for the nominal value 300 HV no longer represents the mean of the upper and lower limits in HRC because of the nonlinear relationship between HV and HRC values (see Figure 5). The confidence interval of the hardness conversion curve may be disregarded for such estimations.



X HV
Y HRC

Figure 5 — Shift of the nominal value when converting hardness values

4.2.2 Uncertainty

The uncertainty of a converted value should be taken from the curves associated with the conversion table used, as shown in the figures in Annexes B to E for various types of material.

The families of curves given in the annexes represent the uncertainty, u, for a probability level of 95 % as a function of the hardness value $\bar{H}_K$ for various reproducibility limits, R. ($\bar{H}_K$ is the corrected arithmetic mean of five individual values.) The curves have been arranged so that interpolation between neighbouring curves is possible. The reproducibility, R, is to be calculated on the basis of five measurements as shown in 4.4.2 for various hardness test methods.

The uncertainty curves only take into account the effects of the random errors of the measured value on the converted value. However, they do not take into account the systematic error of the testing machine used, as this can lead to exceedingly high errors in the converted result, even if the systematic error lies within the permissible range specified for the machine; this is explained in 4.4. For this reason, hardness testing machines shall be verified, using calibrated blocks, at least within the time interval specified in the relevant standards. The systematic error determined in this manner is to be compensated by correcting the measured mean hardness value. This is especially important in the case of Rockwell hardness testing. Figure 6 illustrates the determination of the uncertainty, u, of a converted hardness value (dashed line) according to the example below.

EXAMPLE

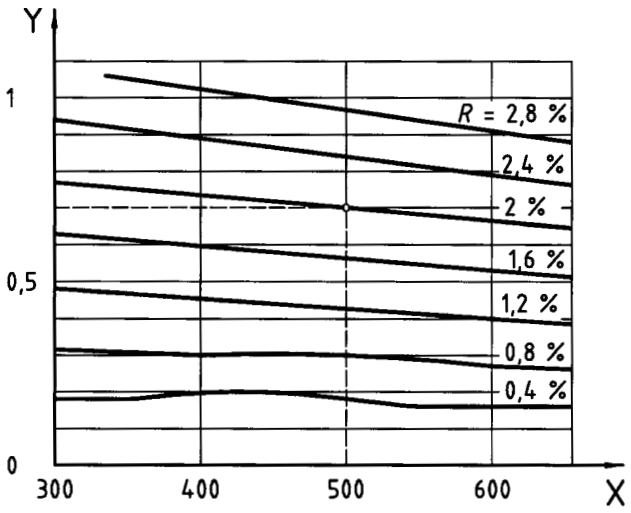
— Measured, corrected mean hardness $\bar{H}_K$ 500 HV

— Converted value as in Annex C 49,5 HRC

— Calculated reproducibility limit, R 2,0 %

— Uncertainty of converted value, u ± 0,7 HRC

标准下载站
anystandards.com



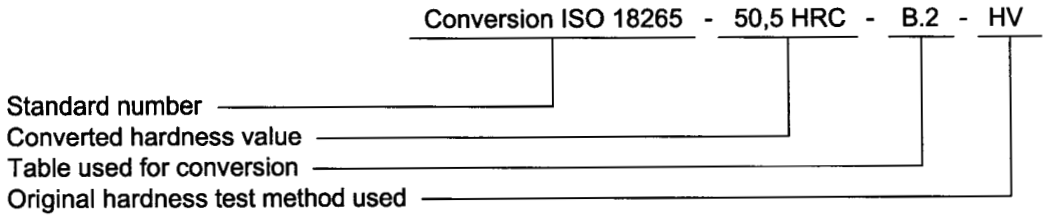
X $\bar{H}_K$ in HV
Y u in HRC

Figure 6 — An example of the determination of uncertainty of a converted hardness value

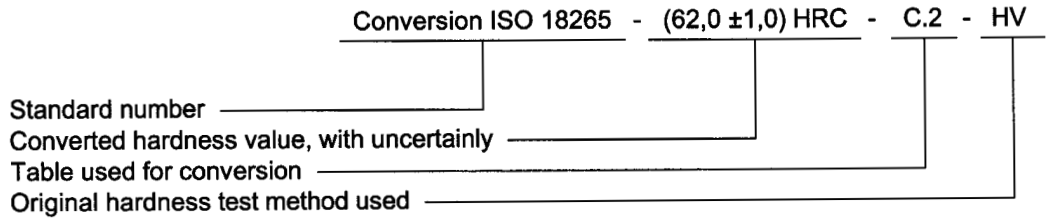
4.3 Designation of conversion results

Conversion results shall be reported in a manner that clearly indicates which method was used to determine the original hardness value. In addition, the relevant annex to this International Standard or the table used shall be given.

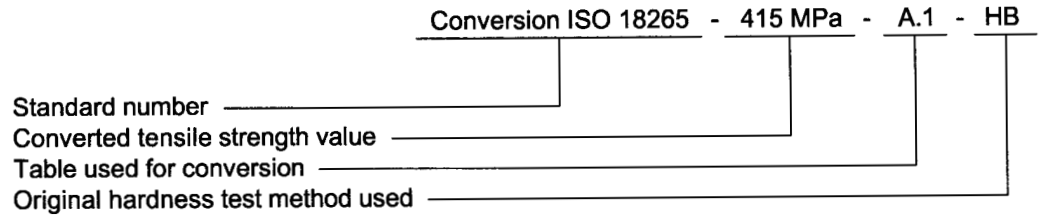
EXAMPLE 1



EXAMPLE 2 If it is agreed that the uncertainty of the converted value is to be given, this shall be included in the result as follows:



EXAMPLE 3 Conversions into tensile strength values shall be expressed as follows:



标准下载站
anystandards.com

4.4 Notes on use of conversion tables

4.4.1 Selection of alternative hardness test methods

4.4.1.1 In Figure 3 hardness scales for non-ferrous metals, hardmetals and selected steels are compared. The relationship of each scale to the Vickers scale is illustrated, and by comparison with Rockwell and Brinell scales (ordinates), information is gained as to the hardness ranges covered by each method. This figure is intended solely as an aid to selection and is not to be used for conversion purposes.

4.4.1.2 Figure 4 shows indentation depths as a function of hardness for various test methods. This should facilitate selection of a suitable test method on the basis of specimen or coating thickness.

4.4.1.3 Another criterion for selecting an alternative hardness test method is the uncertainty of the conversion results. Since this can vary greatly, the uncertainty curves given in this International Standard should also be used to determine which combination of methods is optimal for the application in question.

4.4.2 Calculating the reproducibility limit, R

The reproducibility limit, R, expressed as a percentage, shall be calculated for the different hardness test methods as shown in equations (1) to (3).

For HRB and HRF testing:

$$R = \frac{H_{\max} - H_{\min}}{130 - \bar{H}} \times 100 \qquad (1)$$

For HRC, HRA, HRD, HRN and HRT testing:

$$R = \frac{H_{\max} - H_{\min}}{100 - \bar{H}} \times 100 \qquad (2)$$

where

$H_{\max}$, $H_{\min}$ are the highest and lowest measured hardness values;

$\bar{H}$ is the mean of measured hardness values.

For HV, Vickers microhardness, and HB testing:

$$R = \frac{d_{\max} - d_{\min}}{\bar{d}} \times 100 \qquad (3)$$

where

$d_{\max}$, $d_{\min}$ are the largest and smallest measured indentation diagonals (Vickers) or the largest and smallest diameters (Brinell);

$\bar{d}$ is the mean of measured diagonals or diameters.

4.4.3 Effect of the systematic error

The effect of systematic errors of hardness values on conversion results is illustrated in the following example.

EXAMPLE According to Table E.2, a hardness value of 87,8 HRA corresponds to a converted value of 1 180 HV. In this hardness range, the limits of error of the testing machines (see ISO 6508-2 and ISO 6507-2) are ± 1,5 HRA and ± 23,6 HV, respectively (i.e. ± 2 % of the hardness value). A systematic error of a Rockwell testing machine of + 1,4 HRA lies within the permissible limits of error, although this would still lead to a deviation of 130 HV for the converted value if no correction is made before conversion. Deviations of this magnitude occur particularly when converting from Rockwell to Vickers or Brinell values.

标准下载站
anystandards.com

Annex A
(informative)

Conversion table for unalloyed, low-alloy steels and cast iron

WARNING — Hardness conversions are no substitute for direct measurements. These tables should be used with caution and only in accordance with the principles of conversions, see Clause 3.

A.1 Hardness-to-hardness conversion

When considering the confidence level of converted hardness values, the uncertainty of the hardness test method as well as the width of the conversion scatterband must be taken into account, as shown in Figure A.1. Curve a) characterizes the mean conversion relationship upon which the values given in this annex are based. Curves b_1) and b_2) delineate the areas on either side of a) which take into consideration the different elasticities of the steels tested. In an ideal conversion, the hardness value x_0 becomes y_0. Taking account of the scatterband between b_1) and b_2), practically every hardness value between y_{01} and y_{02} is obtainable. It should be borne in mind that, because the hardness value x_0 is associated with the uncertainty of the relevant test method, the actual hardness can fluctuate between x_1 and x_2 and thus the converted value will lie between y_{11} and y_{22}.

NOTE In the interlaboratory tests carried out by the VDEh (see Introduction), the evaluation of about 700 results for the conversion between HV10 values and HB values produced (graphically depicted) scatterband widths of ± 24 HV10 and ± 23 HB, respectively. Regression analysis was not performed.

A.2 Hardness-to-tensile-strength conversion

While hardness-to-hardness conversion involves considerable scatter and systematic errors, conversion of hardness to tensile strength values produces even greater scattering. One reason for this is the great uncertainty, u, can be affected by microstructural changes (e.g. resulting from heat treatment or cold working) within, even, the same type of steel.

The tensile strength values given in Table A.1 are therefore only approximate values which cannot take the place of the results of tensile testing.

NOTE 1 In the interlaboratory tests carried out by the VDEh, the evaluation of about 700 results for the conversion from HV10 values to tensile strength values produced (graphically depicted) scatterband widths of ± 25 HV10 and ± 85 MPa, respectively. It was also shown that systematic deviations from the mean were possible for particular steel groups. For instance, for pearlitic steels within the hardness range of 300 HV10 to 500 HV10 it was found that the converted tensile values were, on the average, about 100 MPa higher than those listed in Table A.1. Regression analysis was not performed.

NOTE 2 Since high-strength structural steels are now being tested at an increasing rate, the tensile strengths in Table A.1 were extended up to 2 180 MPa. The tensile strength values in this table are based on results of extensive interlaboratory tests by the VDEh in the hardness range up to about 420 HV10, and on the results from [4] which are gradually approached by the values in the range above 420 HV10.

标准下载站
anystandards.com

Table A.1 — Conversion of hardness-to-hardness or hardness-to-tensile-strength values for unalloyed and low-alloy steels and cast iron

Tensile strength MPa	Vickers hardness HV10	Brinell hardness HB[a]	Rockwell hardness							
			HRB	HRF	HRC	HRA	HRD	HR15N	HR30N	HR45N
255	80	76,0								
270	85	80,7	41,0							
285	90	85,5	48,0	82,6						
305	95	90,2	52,0							
320	100	95,0	56,2	87,0						
335	105	99,8								
350	110	105	62,3	90,5						
370	115	109								
385	120	114	66,7	93,6						
400	125	119								
415	130	124	71,2	96,4						
430	135	128								
450	140	133	75,0	99,0						
465	145	138								
480	150	143	78,7	(101,4)						
495	155	147								
510	160	152	81,7	(103,6)						
530	165	156								
545	170	162	85,0	(105,5)						
560	175	166								
575	180	171	87,1	(107,2)						
595	185	176								
610	190	181	89,5	(108,7)						
625	195	185								
640	200	190	91,5	(110,1)						
660	205	195	92,5							
675	210	199	93,5	(111,3)						
690	215	204	94,0							
705	220	209	95,0	(112,4)						
720	225	214	96,0							
740	230	219	96,7	(113,4)						
755	235	223								
770	240	228	98,1	(114,3)	20,3	60,7	40,3	69,6	41,7	19,9
785	245	233			21,3	61,2	41,1	70,1	42,5	21,1
800	250	238	99,5	(115,1)	22,2	61,6	41,7	70,6	43,4	22,2

标准下载站
anystandards.com

Table A.1 (*continued*)

Tensile strength MPa	Vickers hardness HV10	Brinell hardness HB[a]	Rockwell hardness							
			HRB	HRF	HRC	HRA	HRD	HR15N	HR30N	HR45N
820	255	242			23,1	62,0	42,2	71,1	44,2	23,2
835	260	247	(101)		24,0	62,4	43,1	71,6	45,0	24,3
850	265	252			24,8	62,7	43,7	72,1	45,7	25,2
865	270	257	(102)		25,6	63,1	44,3	72,6	46,4	26,2
880	275	261			26,4	63,5	44,9	73,0	47,2	27,1
900	280	266	(104)		27,1	63,8	45,3	73,4	47,8	27,9
915	285	271			27,8	64,2	46,0	73,8	48,4	28,7
930	290	276	(105)		28,5	64,5	46,5	74,2	49,0	29,5
950	295	280			29,2	64,8	47,1	74,6	49,7	30,4
965	300	285			29,8	65,2	47,5	74,9	50,2	31,1
995	310	295			31,0	65,8	48,4	75,6	51,3	32,5
1 030	320	304			32,2	66,4	49,4	76,2	52,3	33,9
1 060	330	314			33,3	67,0	50,2	76,8	53,6	35,2
1 095	340	323			34,4	67,6	51,1	77,4	54,4	36,5
1 125	350	333			35,5	68,1	51,9	78,0	55,4	37,8
1 155	360	342			36,6	68,7	52,8	78,6	56,4	39,1
1 190	370	352			37,7	69,2	53,6	79,2	57,4	40,4
1 220	380	361			38,8	69,8	54,4	79,8	58,4	41,7
1 255	390	371			39,8	70,3	55,3	80,3	59,3	42,9
1 290	400	380			40,8	70,8	56,0	80,8	60,2	44,1
1 320	410	390			41,8	71,4	56,8	81,4	61,1	45,3
1 350	420	399			42,7	71,8	57,5	81,8	61,9	46,4
1 385	430	409			43,6	72,3	58,2	82,3	62,7	47,4
1 420	440	418			44,5	72,8	58,8	82,8	63,5	48,4
1 455	450	428			45,3	73,3	59,4	83,2	64,3	49,4
1 485	460	437			46,1	73,6	60,1	83,6	64,9	50,4
1 520	470	447			46,9	74,1	60,7	83,9	65,7	51,3
1 555	480	456			47,7	74,5	61,3	84,3	66,4	52,2
1 595	490	466			48,4	74,9	61,6	84,7	67,1	53,1
1 630	500	475			49,1	75,3	62,2	85,0	67,7	53,9
1 665	510	485			49,8	75,7	62,9	85,4	68,3	54,7
1 700	520	494			50,5	76,1	63,5	85,7	69,0	55,6
1 740	530	504			51,1	76,4	63,9	86,0	69,5	56,2
1 775	540	513			51,7	76,7	64,4	86,3	70,0	57,0
1 810	550	523			52,3	77,0	64,8	86,6	70,5	57,8

标准下载站
anystandards.com

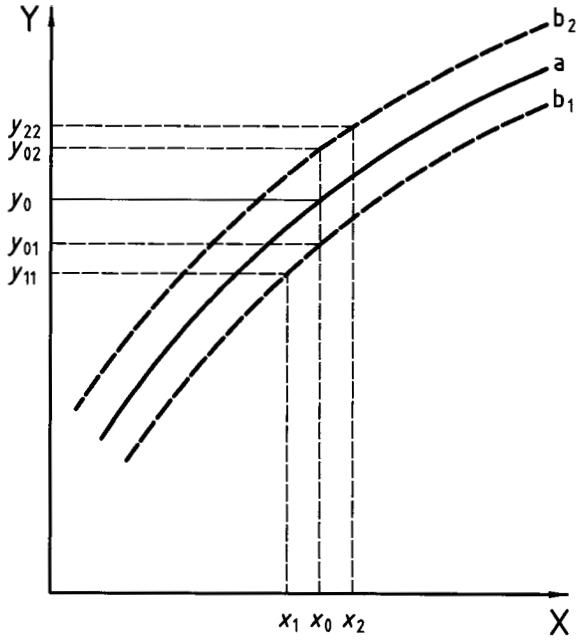
Table A.1 (*continued*)

Tensile strength MPa	**Vickers hardness** HV10	**Brinell hardness** HB[a]	**Rockwell hardness**							
			HRB	HRF	HRC	HRA	HRD	HR15N	HR30N	HR45N
1 845	560	532			53,0	77,4	65,4	86,9	71,2	58,6
1 880	570	542			53,6	77,8	65,8	87,2	71,7	59,3
1 920	580	551			54,1	78,0	66,2	87,5	72,1	59,9
1 955	590	561			54,7	78,4	66,7	87,8	72,7	60,5
1 995	600	570			55,2	78,6	67,0	88,0	73,2	61,2
2 030	610	580			55,7	78,9	67,5	88,2	73,7	61,7
2 070	620	589			56,3	79,2	67,9	88,5	74,2	62,4
2 105	630	599			56,8	79,5	68,3	88,8	74,6	63,0
2 145	640	608			57,3	79,8	68,7	89,0	75,1	63,5
2 180	650	618			57,8	80,0	69,0	89,2	75,5	64,1
	660				58,3	80,3	69,4	89,5	75,9	64,7
	670				58,8	80,6	69,8	89,7	76,4	65,3
	680				59,2	80,8	70,1	89,8	76,8	65,7
	690				59,7	81,1	70,5	90,1	77,2	66,2
	700				60,1	81,3	70,8	90,3	77,6	66,7
	720				61,0	81,8	71,5	90,7	78,4	67,7
	740				61,8	82,2	72,1	91,0	79,1	68,6
	760				62,5	82,6	72,6	91,2	79,7	69,4
	780				63,3	83,0	73,3	91,5	80,4	70,2
	800				64,0	83,4	73,8	91,8	81,1	71,0
	820				64,7	83,8	74,3	92,1	81,7	71,8
	840				65,3	84,1	74,8	92,3	82,2	72,2
	860				65,9	84,4	75,3	92,5	82,7	73,1
	880				66,4	84,7	75,7	92,7	83,1	73,6
	900				67,0	85,0	76,1	92,9	83,6	74,2
	920				67,5	85,3	76,5	93,0	84,0	74,8
	940				68,0	85,6	76,9	93,2	84,4	75,4

[a] Brinell hardness values up to 450 HB were determined using a steel ball indenter, those above this value were determined with a hardmetal ball.

NOTE Values in parentheses are those lying outside the defined range of the standard test method but which may used as estimates.

标准下载站
anystandards.com



X Determined hardness value

Y Converted value

CAUTION — There may be very large scatter bands in the conversions of different kinds of cast iron.

Figure A.1 — Schematic representation of a scatterband for hardness-to-hardness conversion

Annex B
(informative)

Conversion tables for steels for quenching and tempering

WARNING — Hardness conversions are no substitute for direct measurements. These tables should be used with caution and only in accordance with the principles of conversions, see Clause 3.

The values in these conversion tables are based on the results of testing carried out on steels as in TGL 6547 that have been quenched and tempered. The steel grades that were tested are listed in Table B.1, which also provides an overview of the former designations used in the TGL standard along with the corresponding designations as in EN 10083-1. Tables B.2 to B.4 give conversion values for the steels in various heat treatment conditions, while Tables B.5 to B.7 give an overview of the uncertainty curves presented in Figures B.1 to B.68 which are to be used in conjunction with the conversion tables.

NOTE A useful reference book is [24] with information for the comparison of different national and international steel designations with regard to their compositions.

标准下载站
anystandards.com

Table B.1 — Quenching and tempering steels tested

Steel grade (as in TGL 6547)	**Steel grade** (as in EN 10083-1)	
	Material No.	**Name**
C25	1.1158	C25E
C35	1.1180	C35R
CK45	1.1191	C45E
CK55[a]	1.1203	C55E
C60	1.1223	C60R
CK67[b]	c	c
24CrMoV5.5[a]	c	c
30CrMoV9	1.7707	30CrMoV9[d]
30Mn5	1.1165	30Mn5[d]
34Cr4	1.7033	34Cr4
37MnSi5	1.5122	37MnSi5[d]
38CrSi6	1.7038	37CrS4
40Cr4	1.7035	41Cr4
42CrMo4	1.7225	42CrMo4
42MnV7	1.5223	42MnV7[d]
50CrV4	1.8159	51CrV4
50MnSi4	1.5131	50MnSi4[d]
60CrMo4[a]	1.7228	50CrMo4

[a] Not included in TGL 6547.

[b] As in TGL 7975.

[c] Not included in EN 10083-1 and in DIN 17200.

[d] According to DIN 17200:1987-03 (withdrawn, replaced by DIN EN 10083-1) but not included in DIN EN 10083-1 or.

标准下载站
anystandards.com

Table B.2 — Conversion of hardness-to-hardness and hardness-to-tensile-strength values for quenching and tempering steels in the quenched tempered conditions

HV	HBW	HRC	HRA	HR45N	HR30N	HR15N	HRB	HRF	HR45T	HR30T	HR15T	R_m
210	205	(15,3)	57,2	13,4	36,1	65,2	94,8	(110,4)	65,4	76,8	89,2	651
220	215	(17,4)	58,4	15,9	38,1	66,5	96,7	(111,4)	67,6	78,5	90,0	683
230	225	(19,3)	59,6	18,2	40,4	67,8	98,4	(112,4)	69,6	80,0	90,8	716
240	235	21,2	60,6	20,4	41,8	68,9	100,0	(113,3)	71,4	81,4	91,4	748
250	245	22,9	61,6	22,5	43,4	70,0	(101,4)	(114,1)	(73,0)	82,5	92,0	781
260	255	24,6	62,5	24,4	45,0	71,0	(102,7)	(114,9)	(74,4)	83,6	92,5	813
270	266	26,2	63,4	26,3	46,5	72,0	(103,9)	(115,6)	(75,7)	84,5	93,0	845
280	276	27,7	64,3	28,1	47,9	72,9	(105,0)	(116,2)	(76,9)	85,4	93,4	877
290	286	29,1	65,0	29,8	49,3	73,7	(106,0)	(116,8)	(77,9)	86,1	93,7	909
300	296	30,5	65,8	31,4	50,5	74,5	(106,9)	(117,3)	(78,9)	86,8	94,0	940
310	306	31,8	66,5	32,9	51,8	75,3	(107,7)	(117,8)	(79,7)	87,4	(94,3)	972
320	316	33,1	67,2	34,4	52,9	76,0	(108,5)	(118,3)	(80,5)	88,0	(94,6)	1 003
330	326	34,3	67,8	35,8	54,0	76,7	(109,2)	(118,8	(81,2)	88,4	(94,8)	1 035
340	336	35,4	68,5	37,2	55,1	77,3	(109,9)	(119,2)	(81,9)	88,9	(95,0)	1 070
350	345	36,5	69,1	38,4	56,1	78,0	(110,5)	(119,6)	(82,5)	89,3	(95,2)	1 097
360	355	37,6	69,6	39,7	57,1	78,6	(111,1)	(119,9)	(83,0)	89,6	(95,4)	1 128
370	365	38,6	70,2	40,9	58,0	79,1	(111,7)	(120,3)	(83,5)	89,9	(95,5)	1 159
380	375	39,6	70,7	42,0	58,9	79,7	(112,2)	(120,6)	(84,0)	90,2	(95,6)	1 189
390	385	40,6	71,2	43,2	59,8	80,2	(112,7)	(120,9)	(84,4)	90,5	(95,7)	1 220
400	395	41,5	71,7	44,2	60,6	80,7	(113,1)	(121,2)	(84,8)	90,7	(95,8)	1 250
410	405	42,4	72,2	45,3	61,4	81,2	(113,6)	(121,5)	(85,1)	90,9	(95,9)	1 281
420	414	43,2	72,6	46,3	62,2	81,6						1 311
430	424	44,1	73,0	47,2	63,0	82,1						1 341
440	434	44,9	73,5	48,2	63,7	82,5						1 371
450	444	45,7	73,9	49,1	64,4	82,9						1 401
460	453	46,4	74,3	50,0	65,1	83,3						1 430
470	463	47,2	74,6	50,8	65,8	83,7						1 460
480	473	47,9	75,0	51,7	66,4	84,1						
490	482	48,6	75,4	52,5	67,0	84,4						
500	492	49,2	75,7	53,2	67,6	84,8						
510	501	49,9	76,0	54,0	68,2	85,1						

标准下载站 anystandards.com

Table B.2 (*continued*)

HV	HBW	HRC	HRA	HR45N	HR30N	HR15N	HRB	HRF	HR45T	HR30T	HR15T	R_m
520	511	50,5	76,4	54,8	68,8	85,4						
530	520	51,2	76,7	55,5	69,3	85,8						
540	530	51,8	77,0	56,2	69,9	86,1						
550	539	52,4	77,3	56,8	70,4	86,4						
560	549	52,9	77,6	57,5	70,9	86,6						
570	558	53,5	77,9	58,2	71,4	86,9						
580	568	54,0	78,2	58,8	71,9	87,2						
590	577	54,6	78,4	59,4	72,4	87,5						
600	586	55,1	78,7	60,0	72,8	87,7						
610	596	55,6	78,9	60,6	73,3	88,0						
620	605	56,1	79,2	61,2	73,7	88,2						
630	614	56,6	79,4	61,7	74,2	88,5						
640	623	57,1	79,7	62,3	74,6	88,7						
650	632	57,5	79,9	62,8	75,0	88,9						

NOTE Values in parentheses are those lying outside the defined range of the standard test method but which may be used as estimates.

Table B.3 — Conversion of hardness-to-hardness or hardness-to-tensile-strength values for quenching and tempering steels in the untreated, soft annealed or normalized conditions

HV	HBW	HRC	HRA	HR45N	HR30N	HR15N	HRB	HRF	HR45T	HR30T	HR15T	R_m
140												460
150	152	—	(48,4)	—	(21,5)	(56,6)	81,0	102,5	51,6	68,4	85,1	503
160	162	(1,0)	(50,2)	—	(24,4)	(58,3)	83,9	104,1	54,8	70,5	86,2	544
170	173	(4,0)	(51,9)	(0,8)	(27,0)	(60,0)	86,6	105,6	57,7	72,4	87,2	585
180	183	(6,8)	(53,4)	(4,0)	(29,5)	(61,5)	89,0	106,9	60,2	74,1	88,0	624
190	193	(9,4)	(54,8)	(7,0)	(31,8)	(62,9)	91,2	108,1	62,5	75,6	88,8	661
200	203	(11,9)	(56,2)	(9,9)	(34,0)	(64,3)	93,2	109,2	64,6	77,0	89,4	697
210	214	(14,2)	(57,4)	(12,6)	(36,1)	(65,6)	95,0	110,3	66,4	78,3	90,0	732
220	223	(16,4)	(58,6)	(15,1)	(38,1)	66,8	96,7	111,2	68,2	79,5	90,6	765
230	233	(18,5)	(59,7)	17,6	39,9	67,9	98,3	112,2	69,7	80,6	91,1	796
240	243	20,5	60,7	19,9	41,7	69,0	99,8	113,0	71,2	81,6	91,6	826
250	252	22,4	61,7	22,1	43,3	70,0	(101,2)	113,8	(72,5)	(82,6)	92,0	
260	262	24,3	62,6	24,2	44,9	71,0	(102,5)	114,6	(73,7)	(83,5)	92,4	
270	271	26,0	63,5	26,2	46,4	72,0	(103,7)	(115,3)	(74,9)	(84,3)	92,7	
280	280	27,7	64,3	28,1	47,9	72,9	(104,9)	(116,0)	(75,9)	(85,1)	93,0	
290	289	29,2	65,1	29,9	49,2	73,7	(106,0)	(116,6)	(76,9)	(85,8)	(93,3)	
300	298	30,8	65,8	31,6	50,6	74,6	(107,0)	(117,2)	(77,9)	(86,5)	(93,6)	
310	307	32,2	66,6	33,6	51,8	75,4	(108,0)	(117,8)	(78,8)	(87,1)	(93,9)	
320	316	33,6	67,2	35,0	53,0	76,1	(108,9)	(118,4)	(79,6)	(87,8)	(94,1)	

NOTE Values in parentheses are those lying outside the defined range of the standard test method but which may be used as estimates.

标准下载站
anystandards.com

Table B.4 — Conversion of hardness-to-hardness values for quenching and tempering steels in the quenched condition

HV	HBW	HRC	HRA	HR45N	HR30N	HR15N
580	572	54,0	78,1	59,5	71,4	87,2
590	576	54,4	78,4	59,6	71,9	87,4
600	580	54,8	78,6	59,9	72,3	87,6
610	585	55,2	78,8	60,2	72,8	87,8
620	591	55,6	79,1	60,5	73,2	88,0
630	597	56,1	79,3	60,9	73,6	88,2
640	604	56,5	79,6	61,4	74,1	88,4
650	611	56,9	79,8	61,8	74,5	88,7
660	619	57,4	80,1	62,4	75,0	88,9
670	627	57,8	80,3	63,0	75,4	89,1
680	636	58,3	80,6	63,6	75,8	89,4
690	646	58,7	80,9	64,2	76,2	89,6
700	656	59,2	81,1	64,9	76,7	89,8
710	666	59,7	81,4	65,6	77,1	90,1
720	677	60,1	81,7	66,4	77,5	90,3

Table B.5 — Uncertainty curves to be used for conversion as in Table B.2

To obtain uncertainty u, in	of conversion from/to	use figure
HB	HV/HB	B.1
HV	HB/HV	B.2
HRC	HV/HRC	B.3
HV	HRC/HV	B.4
HRA	HV/HRA	B.5
HV	HRA/HV	B.6
HR45N	HV/HR45N	B.7
HV	HR45N/HV	B.10
HR30N	HV/HR30N	B.8
HV	HR30N/HV	B.11
HR15N	HV/HR15N	B.9
HV	HR15N/HV	B.12
HRB	HV/HRB	B.13
HV	HRB/HV	B.14
HRF	HV/HRF	B.15
HV	HRF/HV	B.16
HR45T	HV/HR45T	B.17
HV	HR45T/HV	B.18
HR30T	HV/HR30T	B.19
HV	HR30T/HV	B.20
HR15T	HV/HR15T	B.21
HV	HR15T/HV	B.22
HRC	HRA/HRC	B.23
HRC	HR30N/HRC	B.24
HRB	HRF/HRB	B.25
HRB	HR30T/HRB	B.26
MPa	HV/R_m	B.63
MPa	HB/R_m	B.64
MPa	HRC/R_m	B.65

标准下载站
anystandards.com

Table B.6 — Uncertainty curves to be used for conversion as in Table B.3

To obtain uncertainty u, in	of conversion from/to	use figure
HB	HV/HB	B.27
HV	HB/HV	B.28
HRC	HV/HRC	B.29
HV	HRC/HV	B.30
HRA	HV/HRA	B.31
HV	HRA/HV	B.32
HR45N	HV/HR45N	B.33
HV	HR45N/HV	B.34
HR30N	HV/HR30N	B.35
HV	HR30N/HV	B.36
HR15N	HV/HR15N	B.37
HV	HR15N/HV	B.38
HRB	HV/HRB	B.39
HV	HRB/HV	B.40
HRF	HV/HRF	B.41
HV	HRF/HV	B.42
HR45T	HV/HR45T	B.43
HV	HR45T/HV	B.44
HR30T	HV/HR30T	B.45
HV	HR30T/HV	B.46
HR15T	HV/HR15T	B.47
HV	HR15T/HV	B.48
HRC	HR30N/HRC	B.49
HRB	HR30T/HRB	B.50
MPa	HV/R_m	B.66
MPa	HB/R_m	B.67
MPa	HRC/R_m	B.68

Table B.7 — Uncertainty curves to be used for conversion as in Table B.4

To obtain uncertainty u, in	of conversion from/to	use figure
HB	HV/HB	B.51
HV	HB/HV	B.52
HRC	HV/HRC	B.53
HV	HRC/HV	B.54
HRA	HV/HRA	B.55
HV	HRA/HV	B.56
HR45N	HV/HR45N	B.57
HV	HR45N/HV	B.58
HR30N	HV/HR30N	B.59
HV	HR30N/HV	B.60
HR15N	HV/HR15N	B.61
HV	HR15N/HV	B.62

标准下载站
anystandards.com

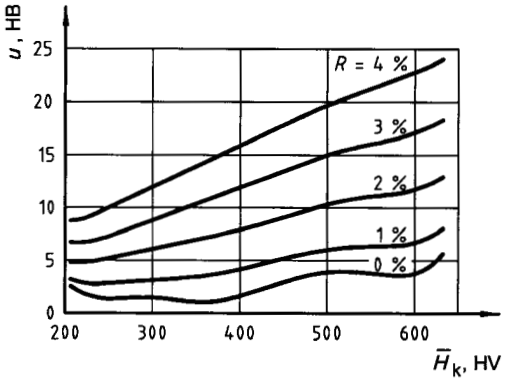


Figure B.1

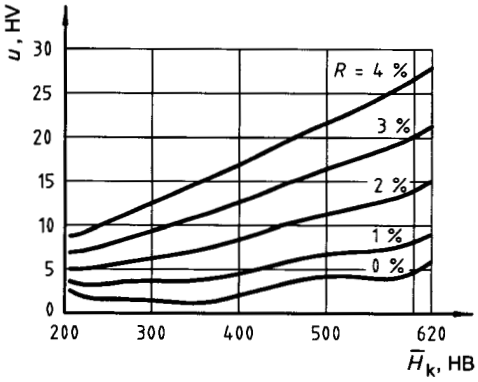


Figure B.2

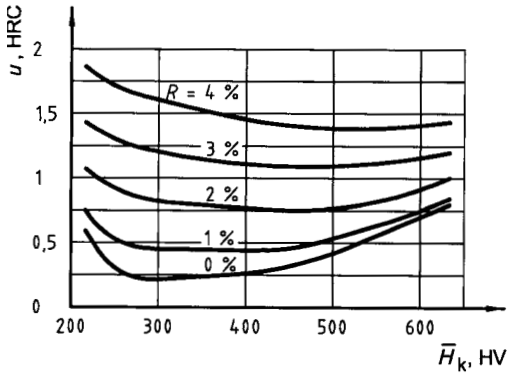


Figure B.3

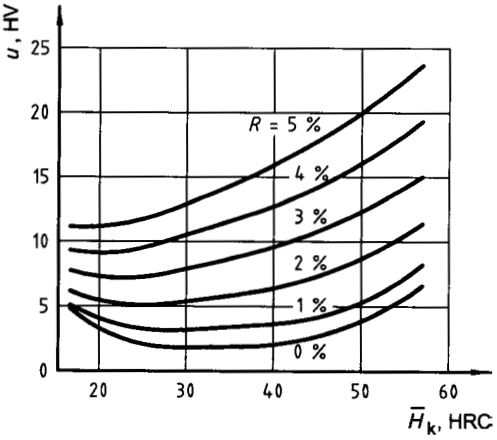


Figure B.4

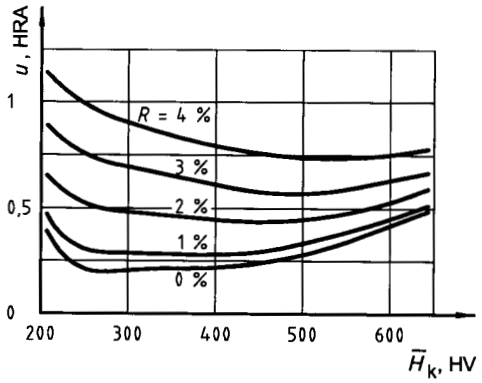


Figure B.5

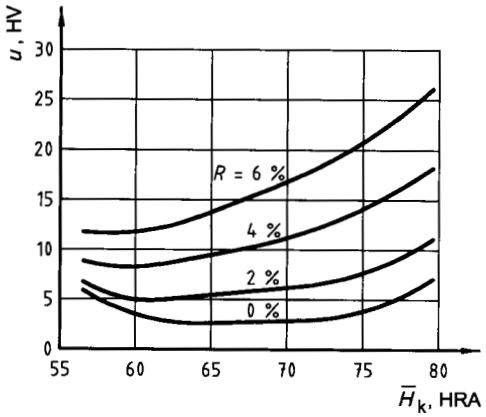


Figure B.6

标准下载站
anystandards.com

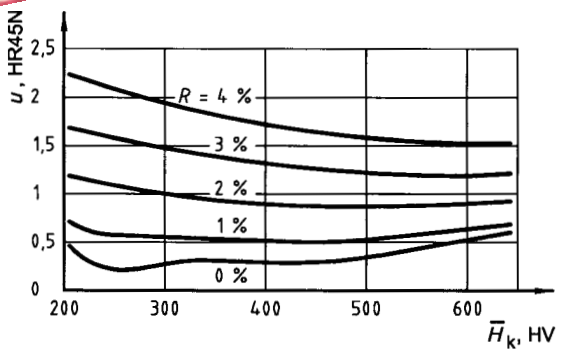


Figure B.7

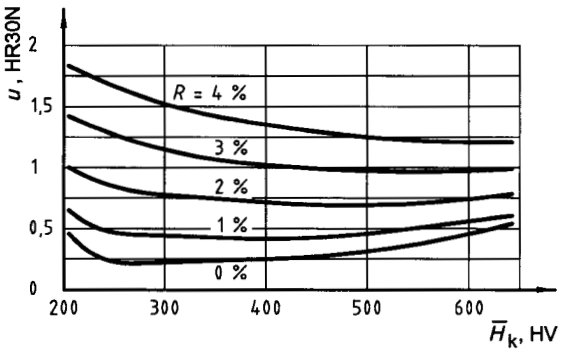


Figure B.8

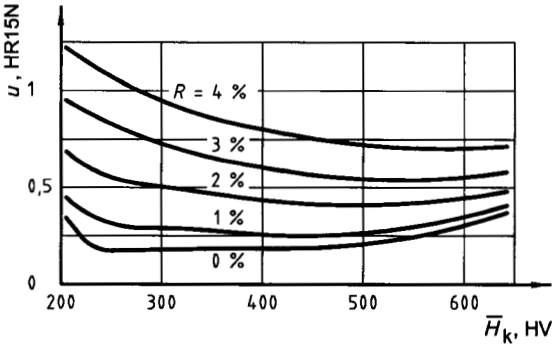


Figure B.9

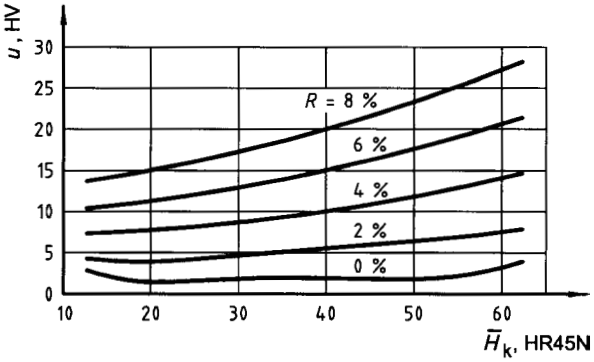


Figure B.10

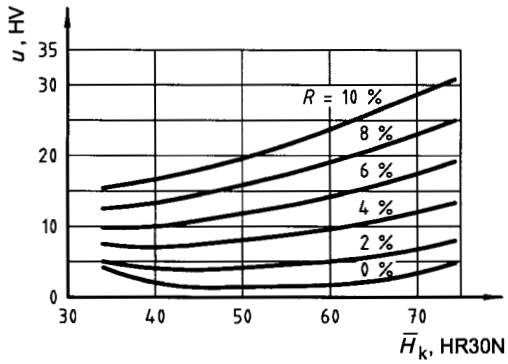


Figure B.11

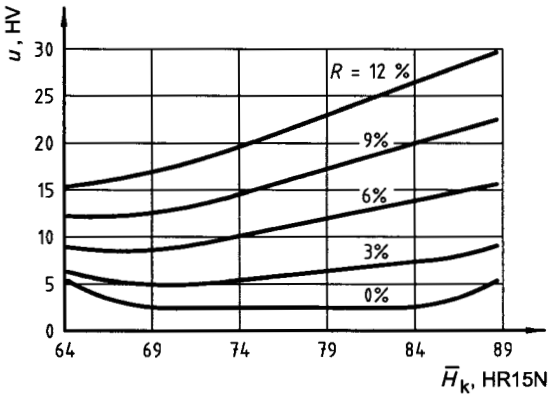


Figure B.12

标准下载站
anystandards.com

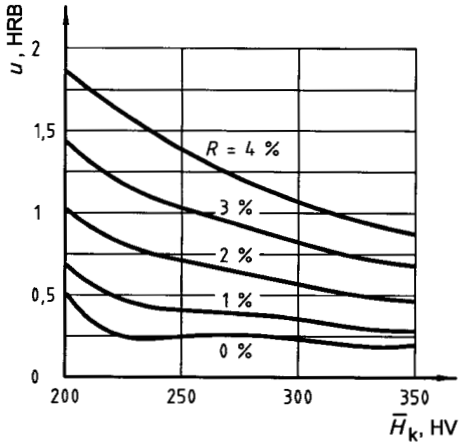


Figure B.13

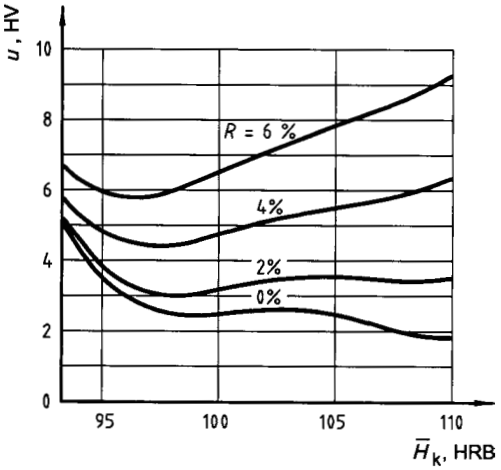


Figure B.14

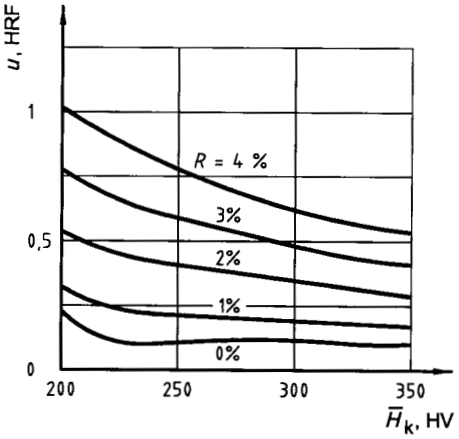


Figure B.15

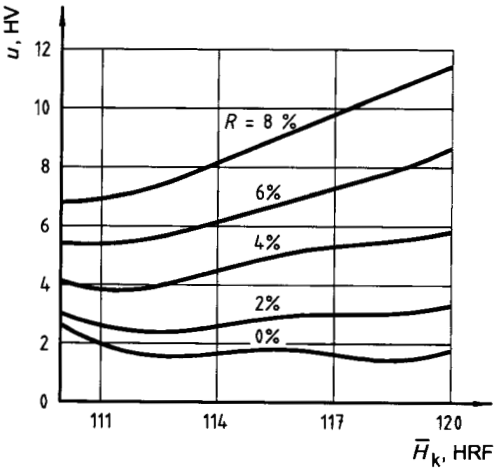


Figure B.16

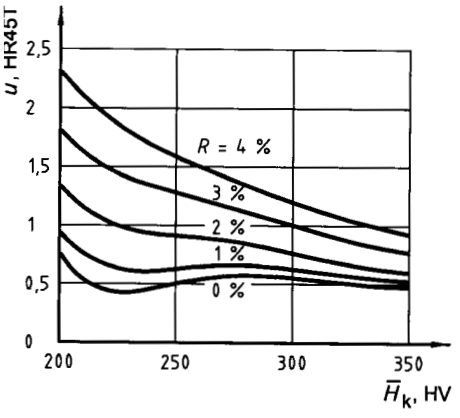


Figure B.17

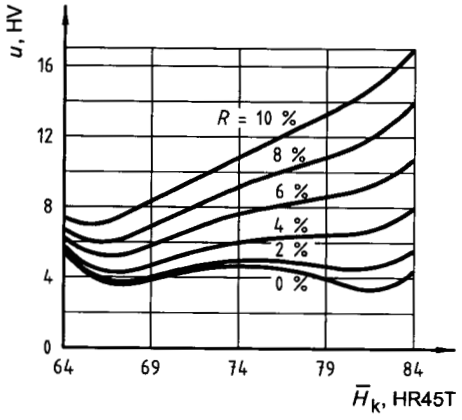


Figure B.18

标准下载站
anystandards.com

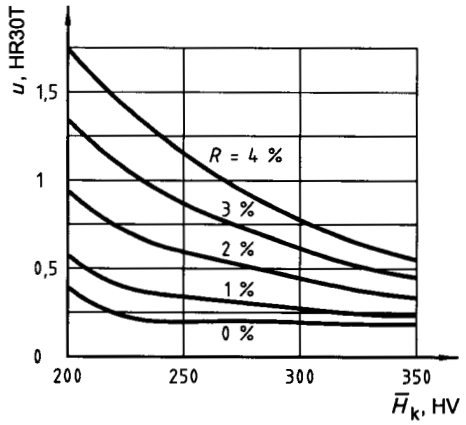


Figure B.19

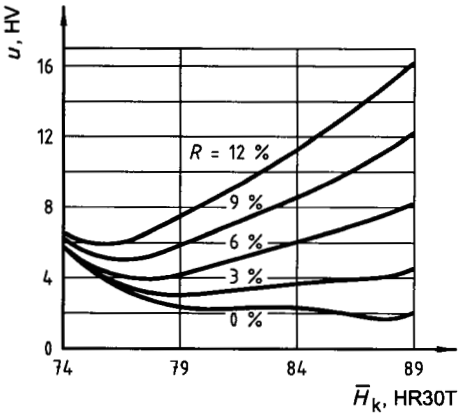


Figure B.20

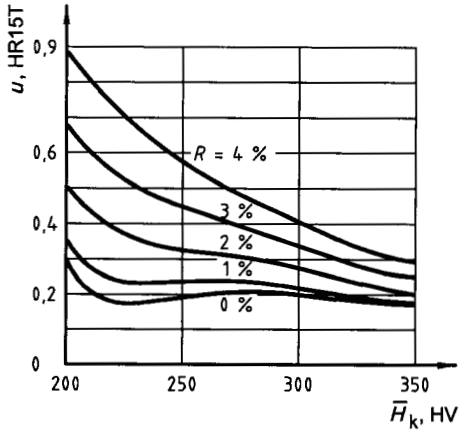


Figure B.21

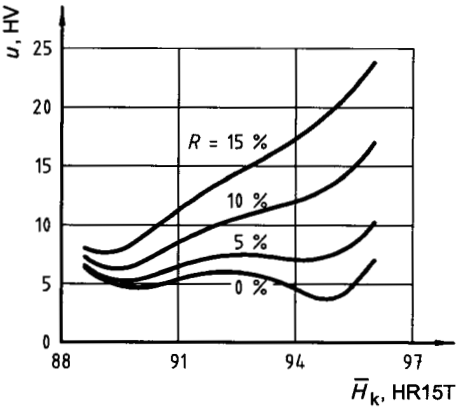


Figure B.22

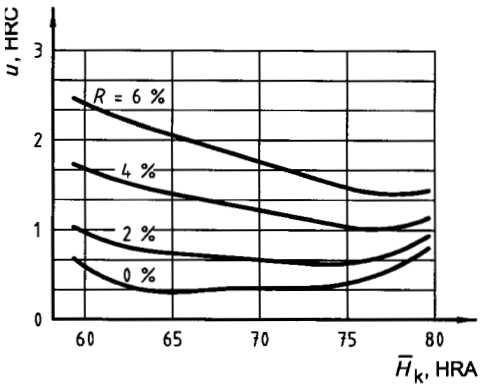


Figure B.23

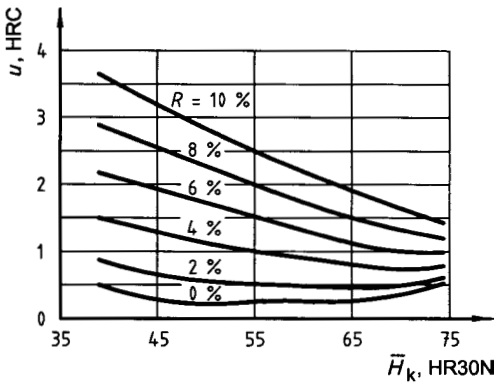


Figure B.24

标准下载站
anystandards.com

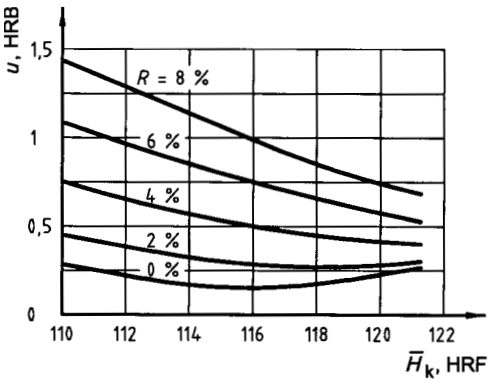


Figure B.25

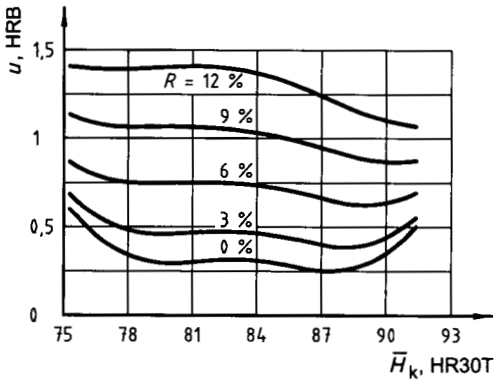


Figure B.26

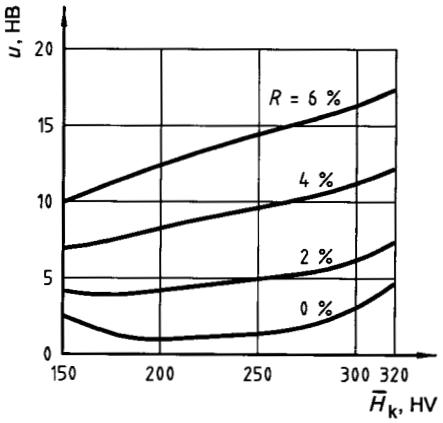


Figure B.27

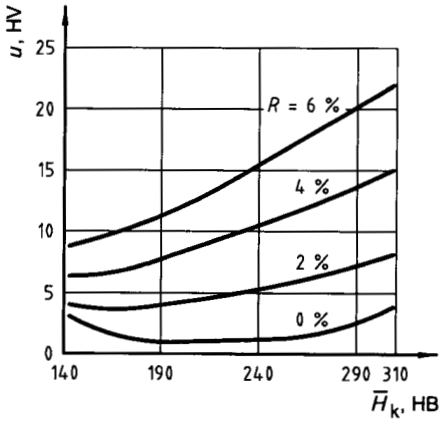


Figure B.28

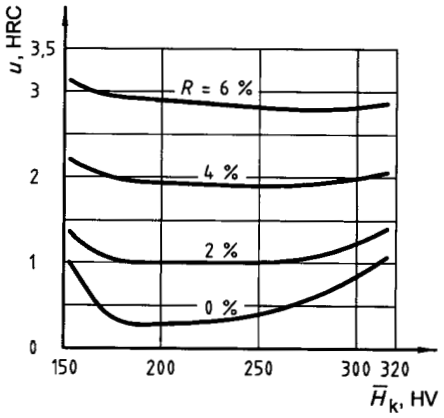


Figure B.29

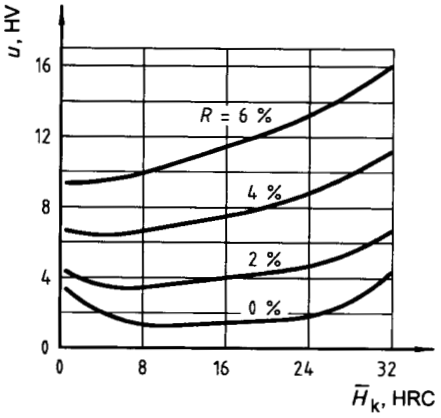


Figure B.30

标准下载站
anystandards.com

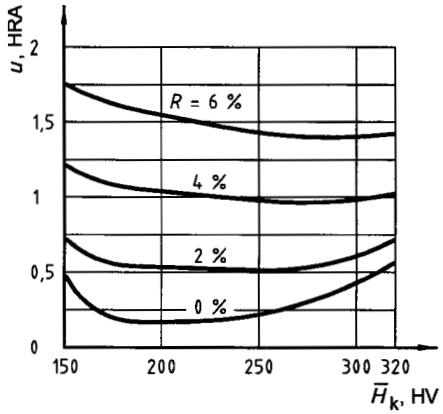


Figure B.31

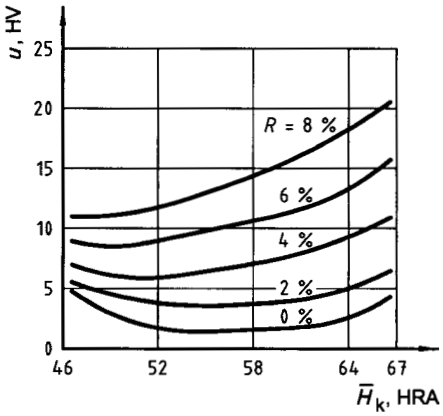


Figure B.32

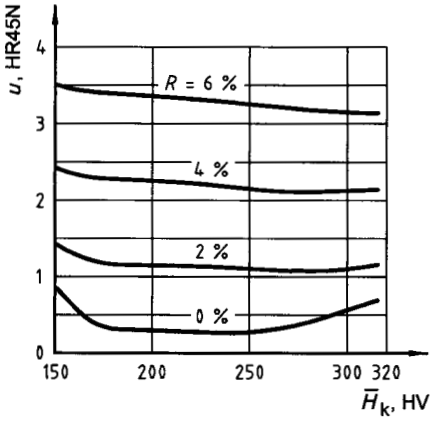


Figure B.33

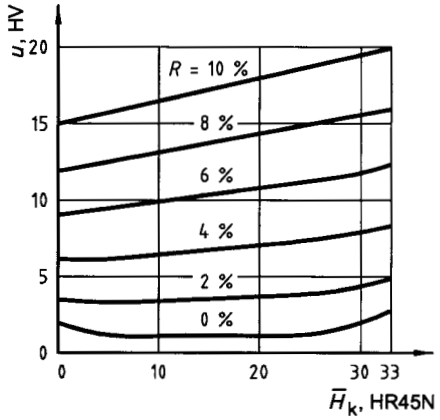


Figure B.34

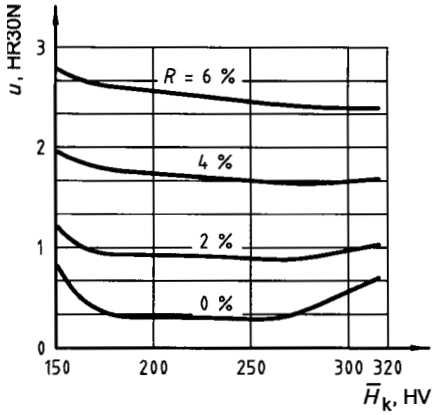


Figure B.35

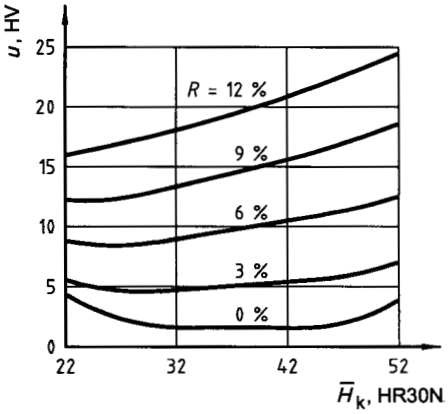


Figure B.36

标准下载站
anystandards.com

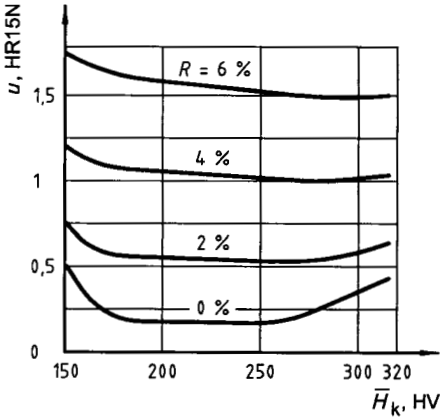


Figure B.37

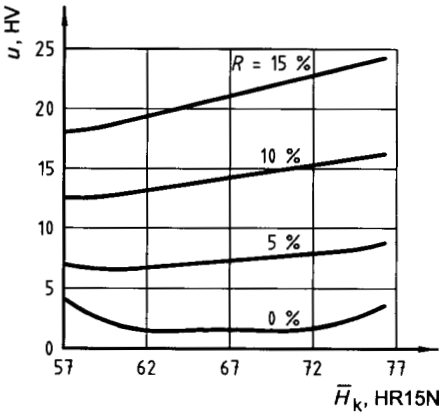


Figure B.38

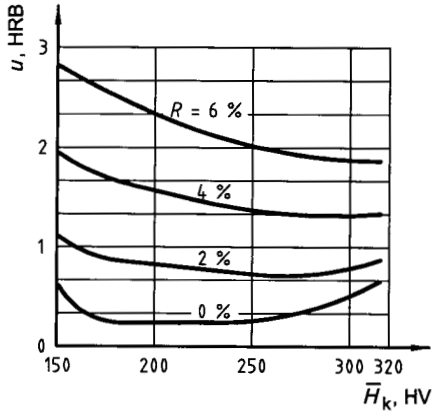


Figure B.39

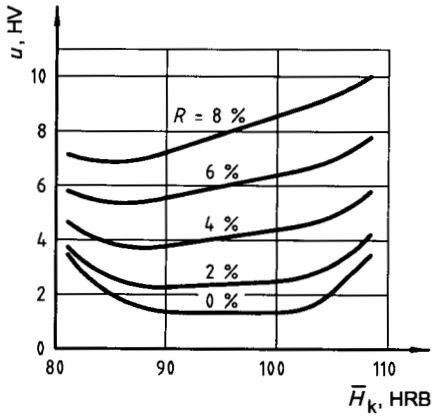


Figure B.40

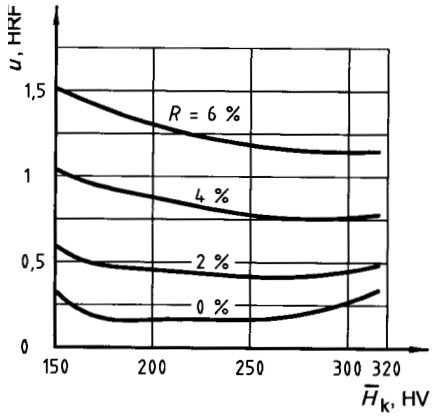


Figure B.41

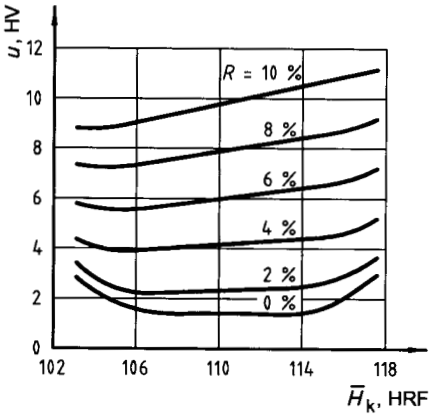


Figure B.42

标准下载站
anystandards.com

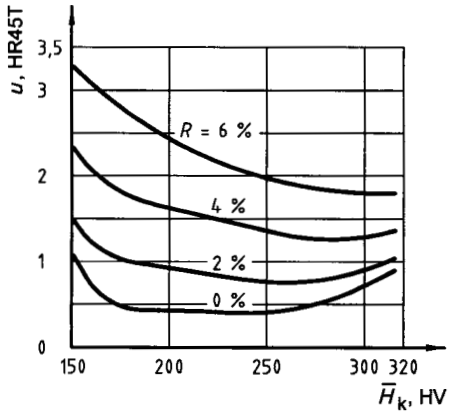


Figure B.43

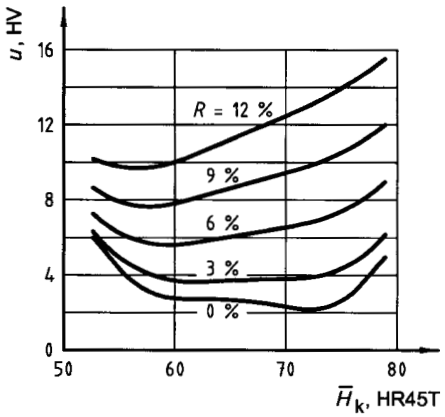


Figure B.44

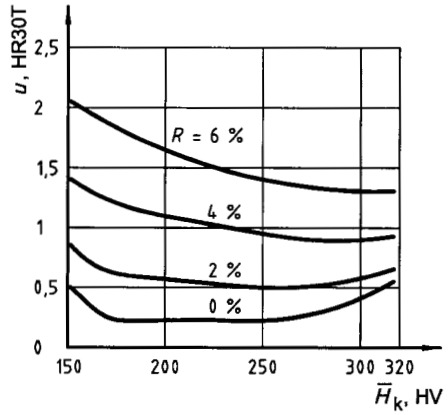


Figure B.45

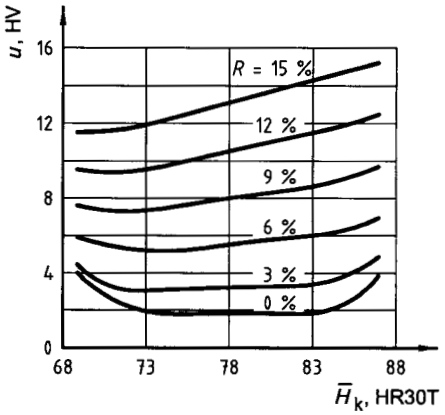


Figure B.46

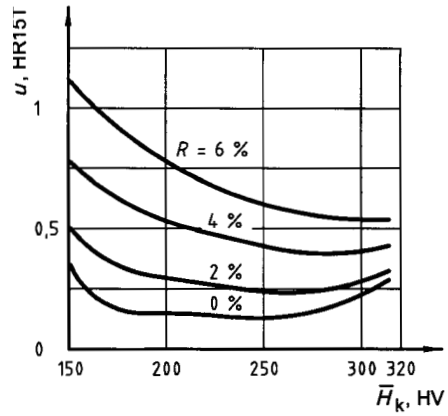


Figure B.47

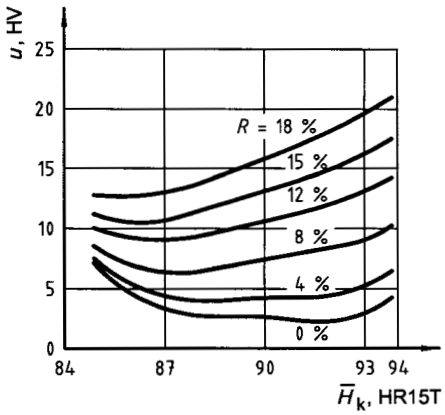


Figure B.48

标准下载站
anystandards.com

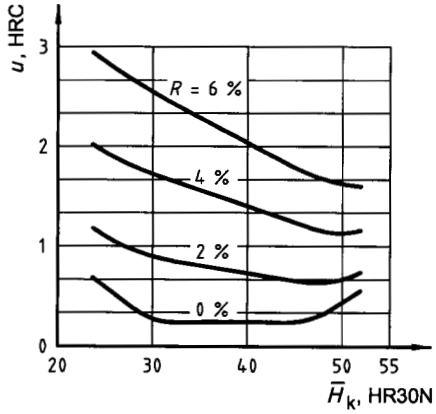


Figure B.49

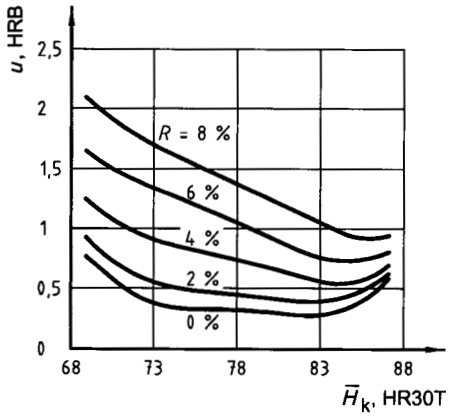


Figure B.50

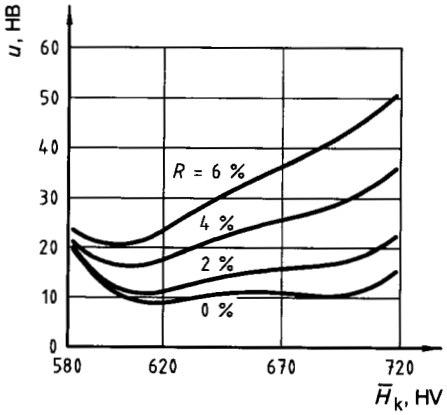


Figure B.51

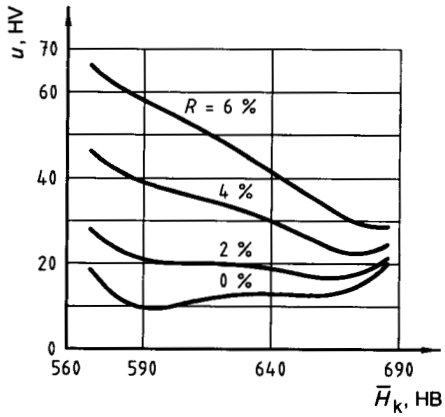


Figure B.52

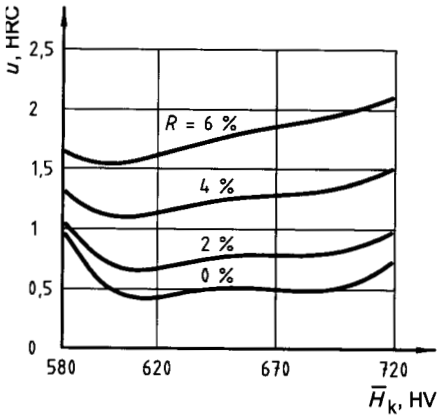


Figure B.53

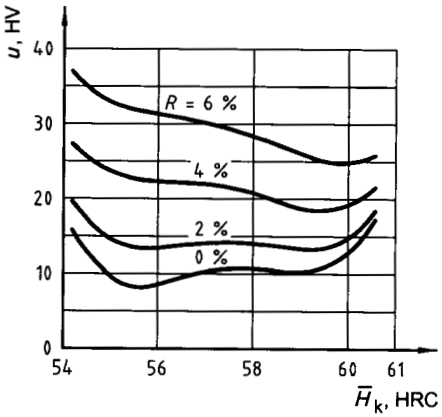


Figure B.54

标准下载站
anystandards.com

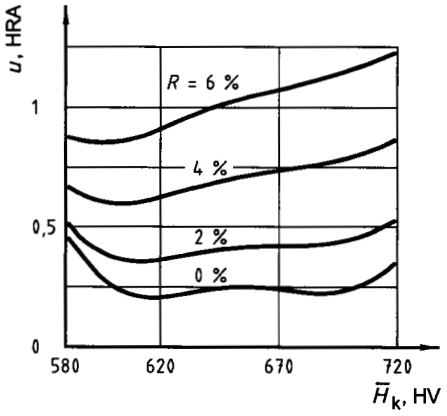


Figure B.55

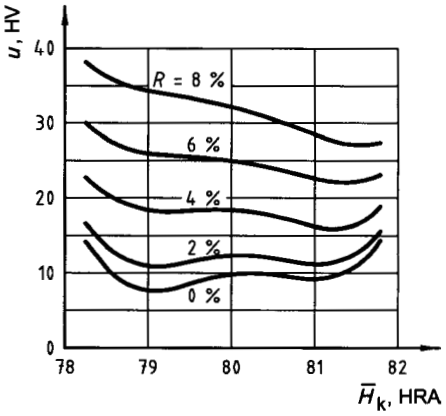


Figure B.56

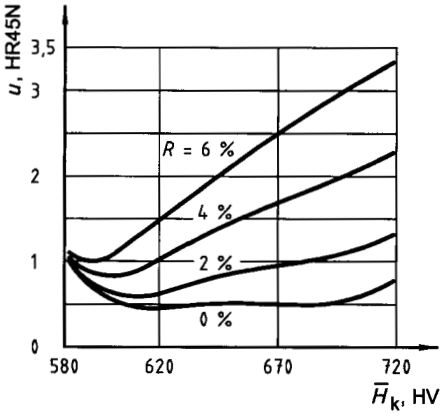


Figure B.57

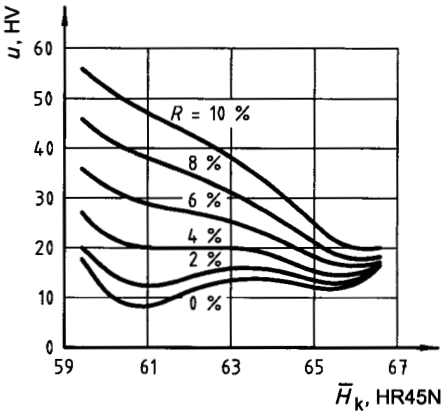


Figure B.58

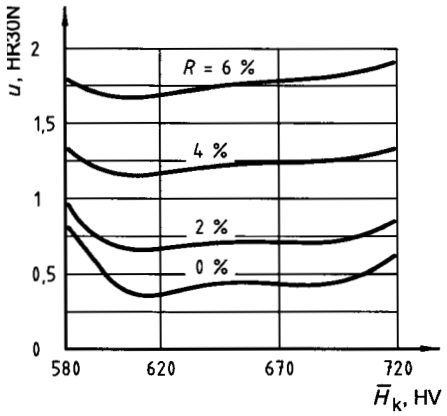


Figure B.59

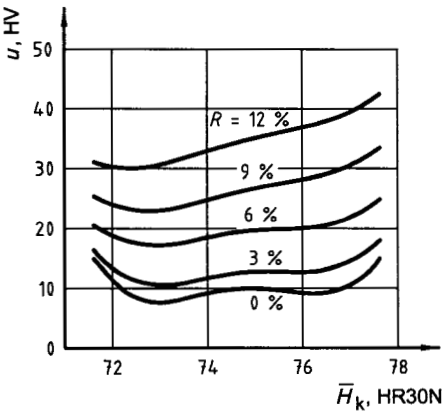


Figure B.60

标准下载站
anystandards.com

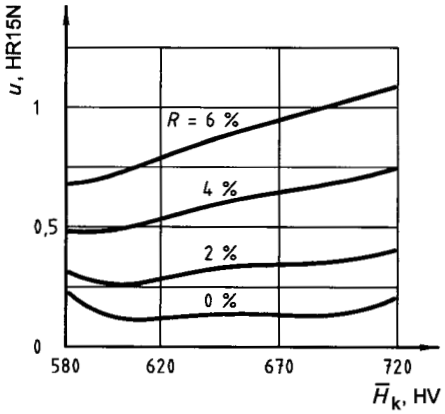


Figure B.61

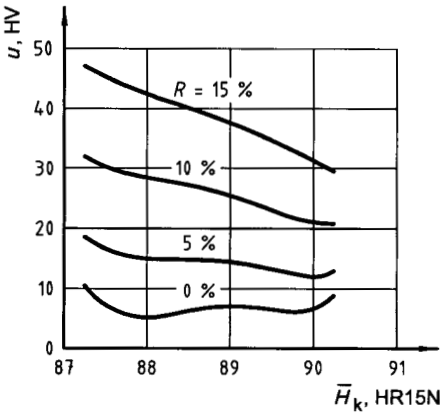


Figure B.62

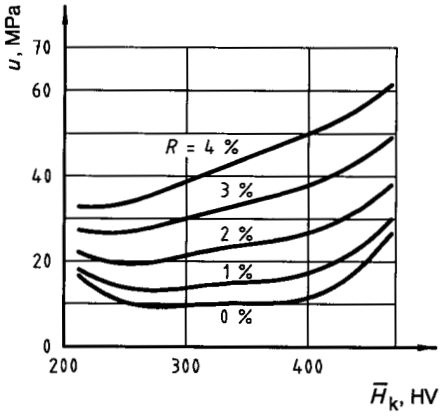


Figure B.63

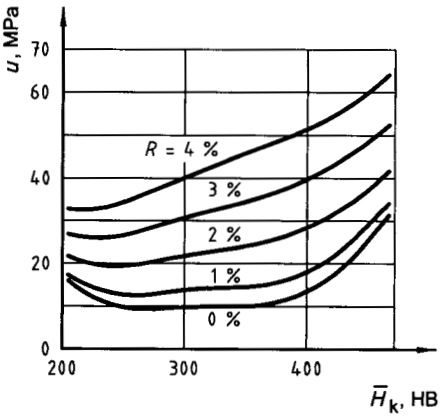


Figure B.64

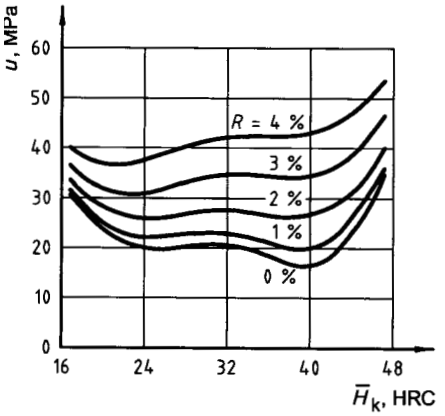


Figure B.65

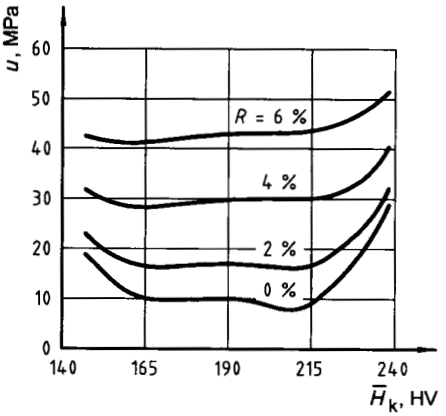


Figure B.66

标准下载站
anystandards.com

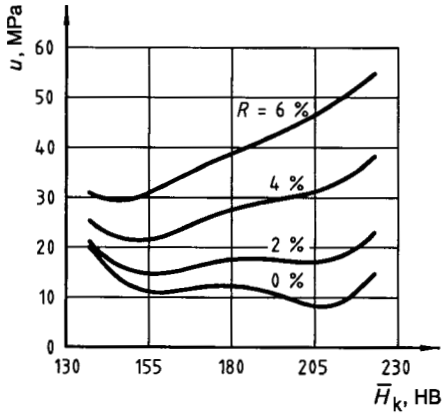


Figure B.67

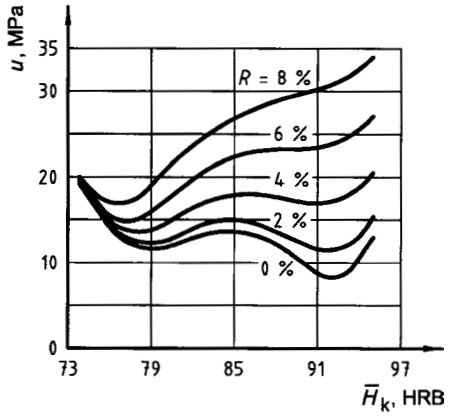


Figure B.68

Annex C
(informative)

Conversion tables for cold working steels

WARNING — Hardness conversions are no substitute for direct measurements. These tables should be used with caution and only in accordance with the principles of conversions, see Clause 3.

This annex presents conversion values for steels for cold working, which have been quenched and tempered. These values are based on results of testing carried out on steels as specified in TGL 4393. The steel grades that were tested are listed in Table C.1, which also provides an overview of the former designations used in the TGL standard along with the corresponding designations as in EN ISO 4957. Table C.2 lists the conversion values, while Table C.3 gives an overview of the uncertainty curves presented in Figures C.1 to C.26 which are to be used in conjunction with the conversion tables.

NOTE A useful reference book is [24] with information for the comparison of different national and international steel designations with regard to their compositions.

Table C.1 — Cold working steels tested

Steel grade (as in TGL 4393)	**Steel grade** (as in EN ISO 4957)	
	Material No.	Name
85CrMo7.2	1.2304	85CrMo7
UR85CrMo7.2	1.2304	85CrMo7
90MnV8	1.2842	90MnCrV8
101Cr6	1.3514	101Cr6LW
UR101Cr6	1.3505[a]	100Cr6
125CrSi5	1.2109	125CrSi5
X125WMo6.5	1.3344[a]	S6-5-3
210Cr46	1.2080	X210Cr12
210CrW46	1.2436	X210CrW12

[a] Chemical composition roughly equivalent to that specified in TGL 4393.

标准下载站
anystandards.com

Table C.2 — Conversion of hardness-to-hardness values for cold working steels

HV	HV 5	HB[a]	HRC	HRA	HR45N	HR30N	HR15N	HRB	HRF	HR45T	HR30T	HR15T
210	212	205	—	—	—	—	—	95,6	(110,7)	66,9	78,0	90,2
220	222	215	(18,8)	59,4	(16,4)	(38,8)	(67,0)	97,2	(111,6)	68,6	79,1	90,7
230	232	225	20,6	60,3	(18,7)	(40,5)	(68,2)	96,7	(112,5)	70,2	80,1	91,2
240	242	235	22,2	62,2	20,9	42,2	(69,3)	110,1	(113,3)	71,6	81,0	91,7
250	252	245	23,9	62,0	23,0	42,8	70,3	(101,4)	(114,0)	72,9	81,9	92,1
260	262	255	25,4	62,8	24,9	45,3	71,3	(102,6)	(114,7)	74,1	(82,7)	92,5
270	272	265	26,9	63,6	26,8	46,8	72,2	(103,7)	(115,3)	75,2	(83,5)	92,9
280	282	275	28,3	64,4	28,6	48,2	73,1	(104,7)	(115,9)	76,3	(84,2)	(93,3)
290	293	285	39,7	65,1	30,2	49,5	73,9	(105,6)	(116,4)	77,3	(84,8)	(93,6)
300	303	295	31,0	65,8	31,9	50,7	74,7	(106,5)	(116,9)	78,2	(85,5)	(93,9)
310	313	304	32,3	66,4	33,4	51,9	75,4	(107,3)	(117,4)	79,1	(86,0)	(94,2)
320	323	314	33,5	67,1	34,9	53,0	76,1	(108,1)	(117,8)	79,9	(86,6)	(94,5)
330	333	324	34,6	67,7	36,3	54,1	76,8	(108,8)	(118,2)	80,6	(87,1)	(94,8)
340	343	334	35,8	68,3	37,6	55,2	77,4	(109,5)	(118,6)	81,4	(87,6)	(95,0)
350	353	344	36,8	68,8	39,0	56,2	78,0	—	—	—	—	—
360	363	354	37,9	69,4	40,2	57,2	78,6					
370	373	363	38,9	69,9	41,4	58,1	79,2					
380	383	373	39,9	70,4	42,6	59,0	79,7					
390	393	383	40,8	71,0	43,7	59,9	80,2					
400	404	392	41,7	71,4	44,8	60,7	80,7					
410	414	402	42,6	71,9	45,8	61,5	81,2					
420	424	412	43,5	72,4	46,9	62,3	81,6					
430	434	422	44,3	72,8	47,8	63,1	82,1					
440	444	431	45,1	73,3	48,8	63,8	82,5					
450	454	441	45,9	73,7	49,7	64,5	82,9					
460	464	450	46,7	74,1	50,5	65,2	83,3					
470	474	460	47,4	74,5	51,4	65,8	83,7					
480	484	469	48,2	74,9	52,2	66,5	84,0					
490	494	479	48,9	75,3	53,1	67,1	84,4					
500	505	488	49,5	75,6	53,9	67,7	84,7					
510	515	498	50,2	76,0	54,6	68,3	85,1					
520	525	507	50,9	76,4	55,4	68,9	85,4					
530	535	517	51,6	76,7	56,2	69,5	85,7					
540	545	526	52,1	77,0	56,8	70,0	86,0					
550	555	535	52,7	77,4	57,6	70,6	83,3					

标准下载站
anystandards.com

Table C.2 (*continued*)

HV	HV 5	HB[a]	HRC	HRA	HR45N	HR30N	HR15N	HRB	HRF	HR45T	HR30T	HR15T
560	565	545	53,3	77,7	58,2	71,1	86,6					
570	575	554	53,9	78,0	58,9	71,6	86,9					
580	585	563	54,5	78,3	59,6	72,1	87,1					
590	595	572	55,0	78,6	60,2	72,6	87,4					
600	606	582	55,6	78,9	60,8	73,0	87,7					
610	616	591	56,1	79,2	61,4	73,5	87,9					
620	626	600	56,6	79,5	62,0	74,0	88,2					
630	636	—	57,1	79,8	62,6	74,4	88,4					
640	646	—	57,6	80,0	63,2	74,8	88,6					
650	656	—	58,1	80,3	63,7	75,3	88,					
660	666		58,6	80,6	64,3	75,7	89,1					
670	676		59,0	80,8	64,8	76,1	89,3					
680	686		59,5	81,0	65,3	76,5	89,5					
690	697		59,9	81,3	65,8	76,9	89,7					
700	707		60,4	81,5	66,3	77,3	89,9					
710	717		60,8	81,8	66,8	77,7	90,1					
720	727		61,2	82,0	67,3	78,0	90,3					
730	737		61,6	82,2	67,8	78,4	90,5					
740	747		62,0	82,5	68,2	78,8	90,7					
750	757		62,4	82,7	68,7	79,1	90,8					
760	767		62,8	82,9	69,1	79,4	91,0					
770	777		63,2	83,1	69,6	79,8	91,2					
780	788		63,6	83,3	70,0	80,1	91,4					
790	798		64,0	83,5	70,4	80,4	91,5					
800	808		64,4	83,7	70,8	80,8	91,7					
810	818		64,7	83,9	71,3	81,1	91,9					
820	828		65,1	84,1	71,7	81,4	92,0					
830	838		65,4	84,3	72,1	81,7	92,2					
840	848		65,8	84,5	72,4	82,0	92,3					

[a] Brinell hardness values up to 450 HB were determined using a steel ball indenter; those above this value were determined with a hardmetal ball.

NOTE Values in parentheses are those lying outside the defined range of the standard test method but which may be used as estimates.

标准下载站
anystandards.com

Table C.3 — Uncertainty curves to be used for conversion as in table C.2

To obtain uncertainty u, in	of conversion from/to	use figure
HV 10, HV 5	HV/HV 10, HV/HV 5	C.1
HV	HV 10/HV, HV 5/ HV	C.2
HB	HV/HB	C.3
HV	HB/HV	C.4
HRC	HV/HRC	C.5
HV	HRC/HV	C.6
HRA	HV/HRA	C.7
HV	HRA/HV	C.8
HR45N	HV/HR45N	C.9
HV	HR45N/HV	C.10
HR30N	HV/HR30N	C.11
HV	HR30N/HV	C.12
HR15N	HV/HR15N	C.13
HV	HR15N/HV	C.14
HRB	HV/HRB	C.15
HV	HRB/HV	C.16
HRF	HV/HRF	C.17
HV	HRF/HV	C.18
HR45T	HV/HR45T	C.19
HV	HR45T/HV	C.20
HR30T	HV/HR30T	C.21
HV	HR30T/HV	C.22
HR15T	HV/HR15T	C.23
HV	HR15T/HV	C.24
HRB	HRF/HRB	C.25
HRB	HR30T/HRB	C.26
HRC	HR30N/HRC	C.27
HRC	HRA/HRC	C.28

标准下载站
anystandards.com

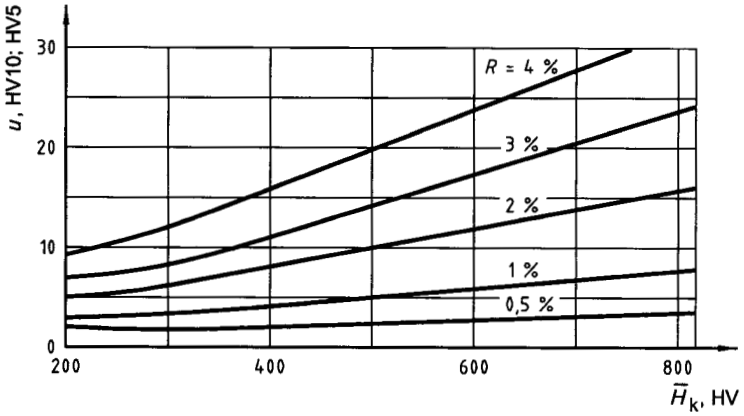


Figure C.1

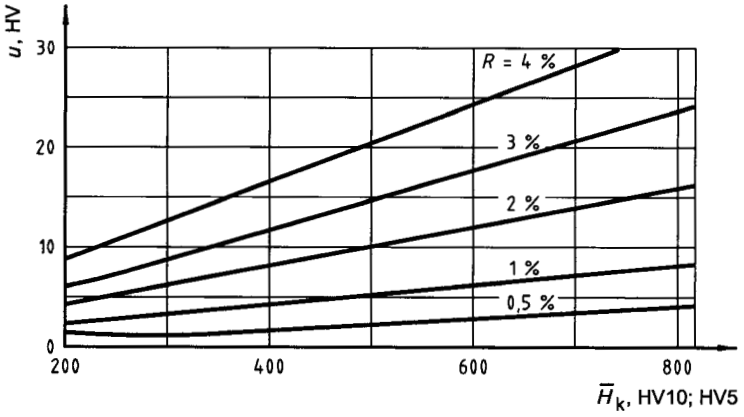


Figure C.2

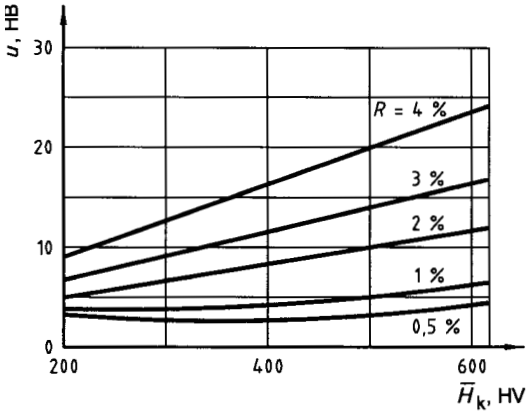


Figure C.3

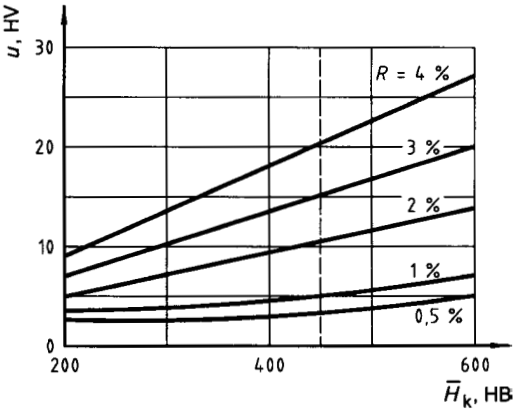


Figure C.4

标准下载站
anystandards.com

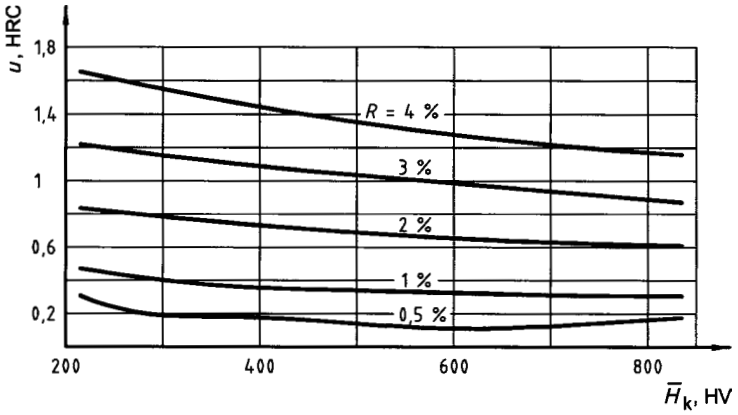


Figure C.5

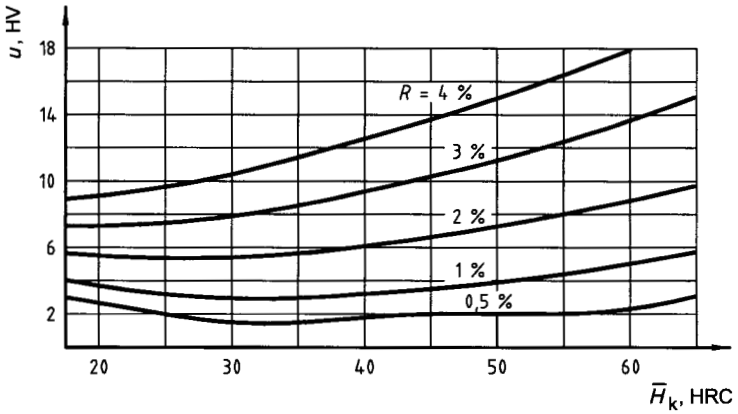


Figure C.6

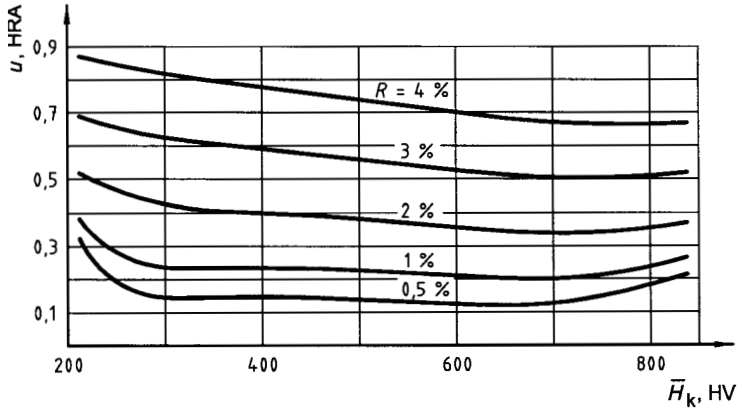


Figure C.7

标准下载站
anystandards.com

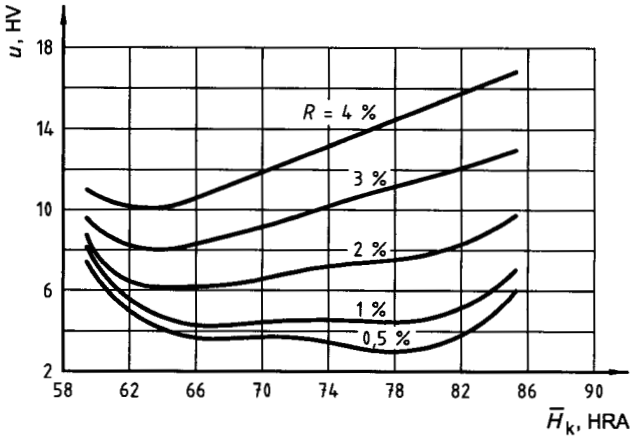


Figure C.8

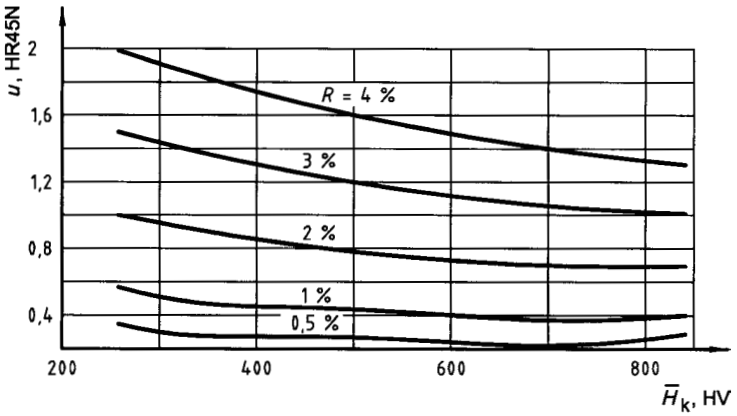


Figure C.9

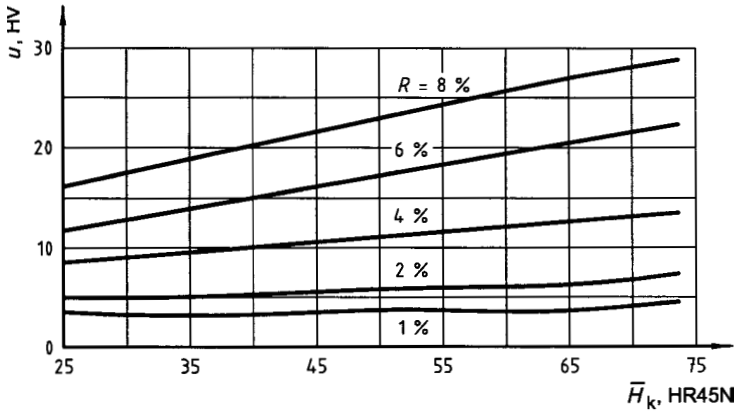


Figure C.10

标准下载站
anystandards.com

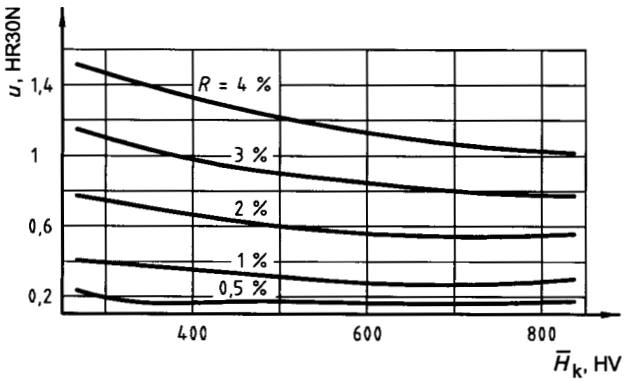


Figure C.11

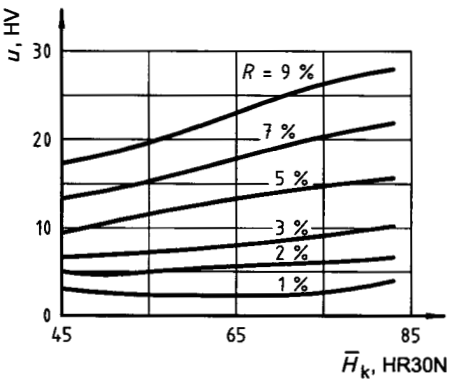


Figure C.12

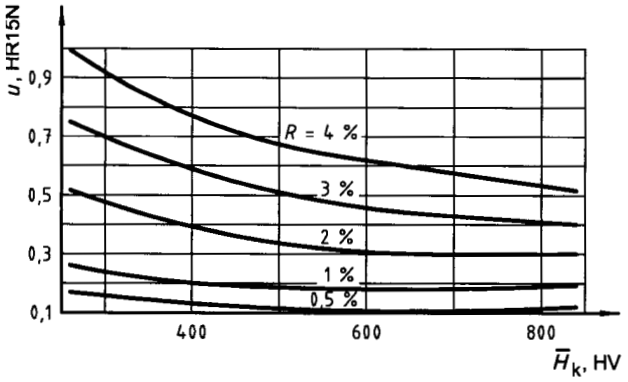


Figure C.13

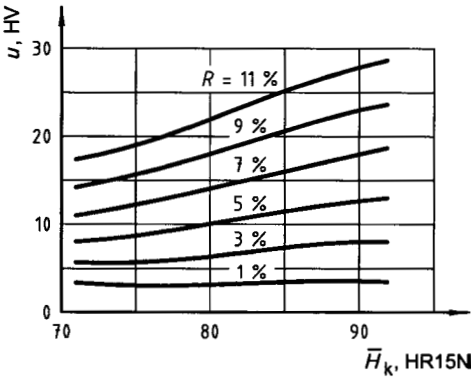


Figure C.14

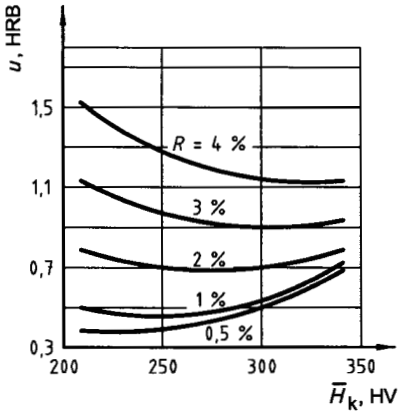


Figure C.15

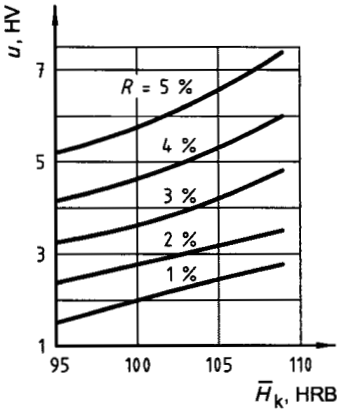


Figure C.16

标准下载站
anystandards.com

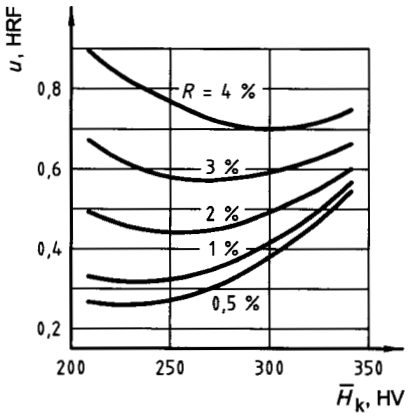


Figure C.17

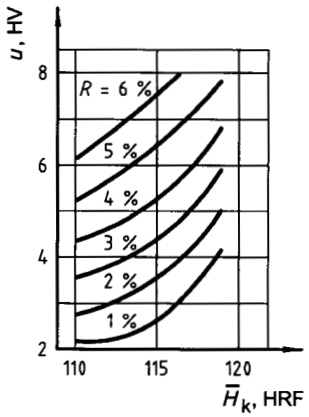


Figure C.18

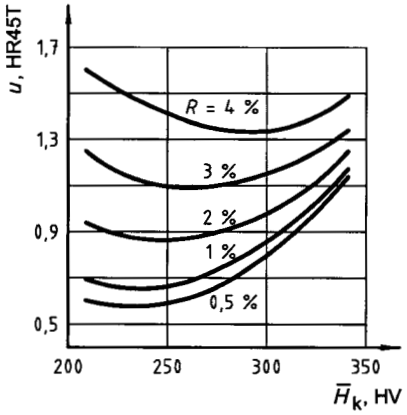


Figure C.19

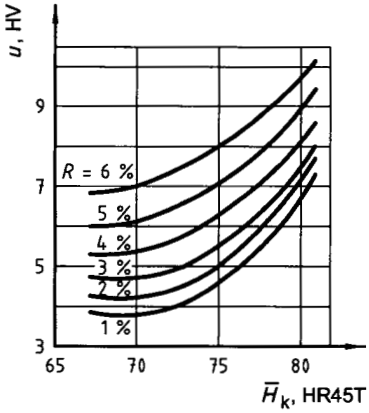


Figure C.20

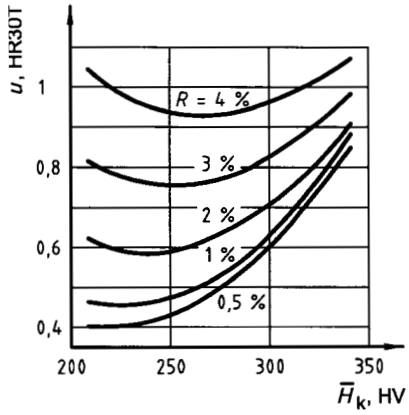


Figure C.21

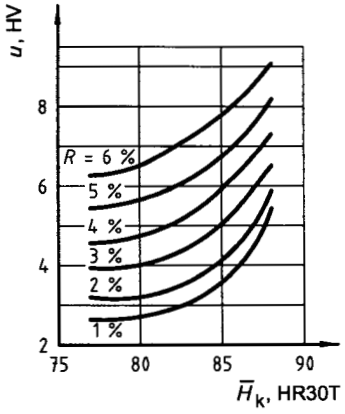


Figure C.22

标准下载站
anystandards.com

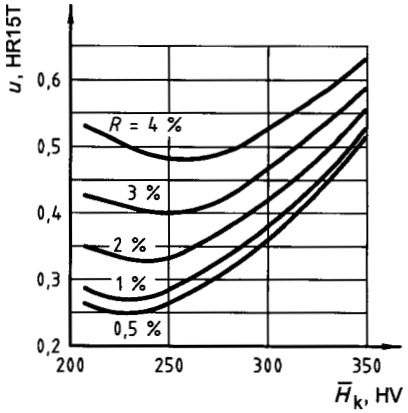


Figure C.23

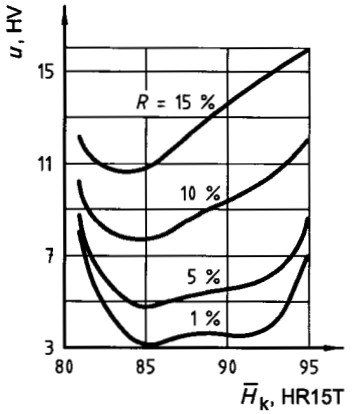


Figure C.24

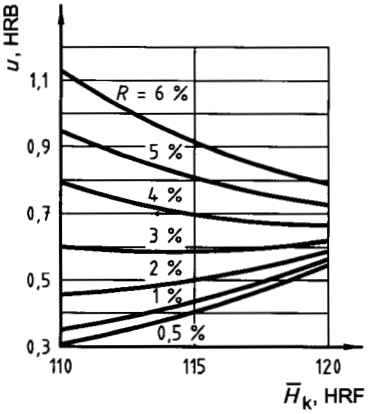


Figure C.25

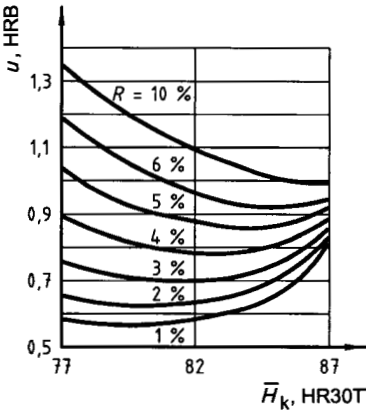


Figure C.26

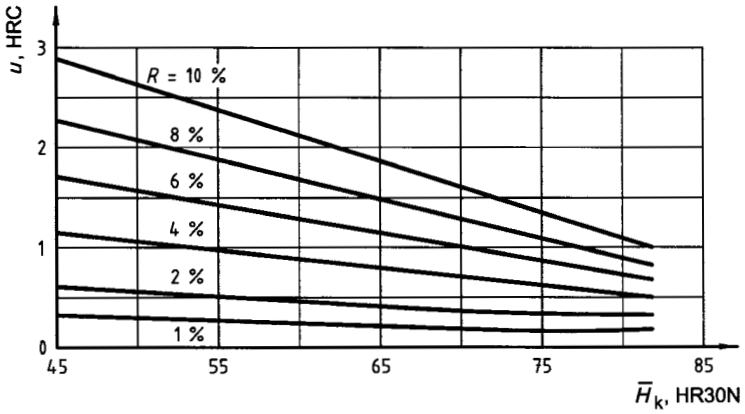


Figure C.27

标准下载站
anystandards.com

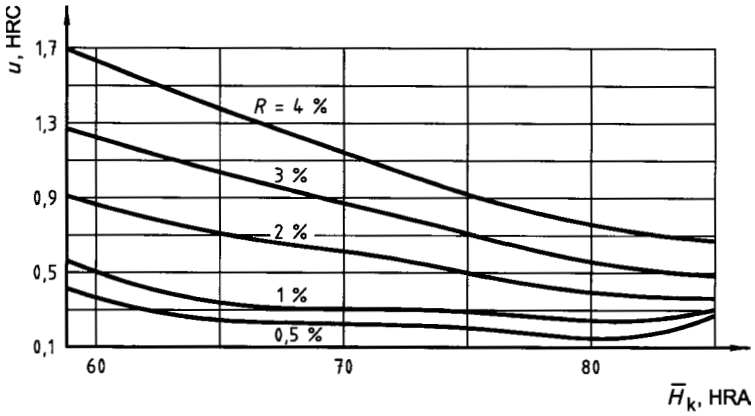


Figure C.28

Annex D
(informative)

Conversion tables for high speed steels

WARNING — Hardness conversions are no substitute for direct measurements. These tables should be used with caution and only in accordance with the principles of conversions, see Clause 3.

This annex presents conversion values for high speed steels that have been quenched and tempered above the secondary hardening peak. These values are based on results of testing carried out on the high speed steel grades as in TGL 7571, listed in Table D.1, which also provides an overview of the former designations used in the TGL standard along with the corresponding designations as in EN ISO 4957. Tables D.2, D.4, D.6 and D.8 list the conversion values, whilst Tables D.3, D.5, D.7 and D.9 give an overview of the uncertainty curves presented in Figures D.1 to D.30 which are to be used in conjunction with the conversion tables.

NOTE A useful reference book is [24] with information for the comparison of different national and international steel designations with regard to their compositions.

Table D.1 — High speed steels tested

Steel grade (as in TGL 7571)	**Steel grade** (as in EN ISO 4957)	
	Material No.	Name
X80WMo6.5		X80WMo6.5
X82WMo6.5		X82WMo6.5
X90WMo6.5	1.3343	X90WMo6.5
X97WMo3.3		X97WMo3.3
X100WMo6.5	1.3342	X100WMo6.5
X85WMoCo6.5.5	1.3243	X85WMoCo6.5.5
X105WMoCo6.5.5	1.3355	X105WMoCo6.5.5
X79WCo18.5	1.3255	X79WCo18.5
X110MoCo9.8	1.3247	X110MoCo9.8
NOTE Where no material number is listed, no equivalent number could be found in EN ISO 4957.		

标准下载站
anystandards.com

Table D.2 — Conversion of hardness-to-hardness values for high speed steels of steel grades X80WMo6.5, X82WMo6.5, X90WMo6.5, X97WMo3.3, X100WMo6.5, X85WMoCo6.5.5, X105WMoCo6.5.5 and X79WCo18.5

Vickers hardness	Rockwell hardness				
	HRC	HRA	HR45N	HR30N	HR15N
580	54,2	77,9	58,8	71,7	87,1
590	54,7	78,2	59,4	72,2	87,4
600	55,2	78,5	60,0	72,6	87,6
610	55,7	78,7	60,6	73,1	87,8
620	56,2	75,0	61,1	73,5	88,1
630	56,6	79,3	61,7	74,0	88,3
640	57,1	79,6	62,2	74,4	88,5
650	57,6	79,8	62,8	74,8	88,7
660	58,0	80,1	63,3	75,2	88,9
670	58,5	80,3	63,8	75,6	89,1
680	58,9	80,6	64,3	76,0	89,3
690	59,3	80,8	64,8	76,4	89,5
700	59,7	81,0	65,3	76,7	89,7
710	60,2	81,3	65,8	77,1	89,9
720	60,6	81,5	66,3	77,4	90,1
730	61,0	81,7	66,7	77,8	90,2
740	61,4	82,0	67,2	78,1	90,4
750	61,8	82,2	67,6	78,5	90,6
760	62,1	82,4	68,1	78,8	90,7
770	62,5	82,6	68,5	79,1	90,9
780	62,9	82,8	68,9	79,5	91,0
790	63,3	83,0	69,4	79,8	91,2
800	63,6	83,2	69,8	80,1	91,3
810	64,0	83,5	70,2	80,4	91,5
820	64,3	83,6	70,6	80,7	91,6
830	64,7	83,8	71,0	81,0	91,8
840	65,0	84,0	71,4	81,3	91,9
850	65,4	84,2	71,7	81,6	92,0
860	65,7	84,4	72,1	81,8	92,2
870	66,0	84,6	72,5	82,1	92,3
880	66,3	84,8	72,8	82,4	92,4
890	66,7	85,0	73,2	82,7	92,5
900	67,0	85,0	73,6	82,9	92,6
910	67,3	85,3	73,9	83,2	92,8
920	67,6	85,5	74,2	83,4	92,9

标准下载站
anystandards.com

Table D.3 — Uncertainty curves to be used for conversion as in Table D.2

To obtain uncertainty u, in	of conversion from/to	use figure
HRC	HV/HRC	D.1
HV	HRC/HV	D.2
HRA	HV/HRA	D.3
HV	HRA/HV	D.4
HR45N	HV/HR45N	D.5
HR30N	HV/HR30N	D.6
HR15N	HV/HR15N	D.7
HV	HR45N/HV	D.8
HV	HR30N/HV	D.9
HV	HR15N/HV	D.10
HRC	HRA/HRC	D.11
HRC	HR30N/HRC	D.12

Table D.4 — Conversion between various Vickers hardness scales for high speed steels of steel grades X80WMo6.5, X82WMo6.5, X90WMo6.5, X97WMo3.3, X100WMo6.5, X85WMoCo6.5.5 and X105WMoCo6.5.5

HV	HV 10	HV 5
580	587	589
590	598	599
600	608	609
610	618	620
620	628	630
630	638	640
640	648	650
650	658	660
660	669	670
670	679	681
680	689	691
690	699	701
700	709	711
710	719	721
720	730	731
730	740	742
740	750	752

HV	HV 10	HV 5
750	760	762
760	770	772
770	780	782
780	790	792
790	801	802
800	811	813
810	821	823
820	831	833
830	841	843
840	851	853
850	862	863
860	872	874
870	882	884
880	892	984
890	902	904
900	912	914
910	923	924
920	933	935

标准下载站
anystandards.com

Table D.5 — Uncertainty curves to be used for conversion as in Table D.4

To obtain uncertainty u, in	of conversion from/to	use figure
HV 10, HV 5	HV/HV 10, HV/HV5	D.13
HV	HV 10/HV, HV5/HV	D.14

Table D.6 — Conversion between various Vickers hardness scales for high speed steels of steel grade X79WCo18.5

HV	HV 10	HV 5
790	795	794
800	806	805
810	817	816
820	828	826
830	839	837
840	850	847
850	861	858
860	872	868
870	883	879
880	894	890
890	905	900
900	916	911
910	927	921
920	938	932

Table D.7 — Uncertainty curves to be used for conversion as in Table D.6

To obtain uncertainty u, in	of conversion from/to	use figure
HV 10	HV/HV 10	D.15
HV	HV 10/HV	D.16
HV 5	HV/HV 5	D.17
HV	HV 5/HV	D.18

标准下载站
anystandards.com

Table D.8 — Conversion of hardness-to-hardness values for high speed steels of steel grade X110MoCo9.8

Vickers hardness		Rockwell hardness					
HV	HV 10	HV 5	HRC	HRA	HR45N	HR30N	HR15N
740	—	—	—	82,0	67,8	77,9	90,7
750	—	—	—	82,2	68,1	78,3	90,8
760	—	—	—	82,5	68,4	78,6	90,9
770	768	759	63,2	82,7	68,8	79,0	91,0
780	779	770	63,5	82,9	69,1	79,3	91,1
790	790	781	63,9	83,1	69,4	79,6	91,2
800	801	791	64,2	83,3	69,7	79,9	91,3
810	812	802	64,5	83,5	70,0	80,2	91,4
820	822	813	64,8	83,7	70,3	80,5	91,6
830	833	823	65,1	83,8	70,6	80,8	91,7
840	844	834	65,4	84,0	71,0	81,0	91,8
850	855	845	65,7	84,2	71,3	81,3	91,9
860	866	856	66,0	84,4	71,6	81,5	92,0
870	876	866	66,3	84,5	71,9	81,8	92,1
880	887	877	66,6	84,7	72,2	82,0	92,2
890	898	888	66,9	84,8	72,5	82,3	92,4
900	909	899	67,1	85,0	72,8	82,5	92,5
910	920	909	67,4	85,1	73,1	82,7	92,6
920	931	920	67,6	85,3	73,4	83,0	92,7
930	942	931	67,9	85,4	73,7	83,2	92,8
940	—	—	68,2	85,5	74,0	83,4	92,9
950	—	—	—	85,7	74,3	83,6	93,0

Table D.9 — Uncertainty curves to be used for conversion as in Table D.8

To obtain uncertainty u, in	of conversion from/to	use figure
HV10	HV/HV10	D.15
HV	HV10/HV	D.16
HV5	HV/HV5	D.17
HV	HV5/HV	D.18
HRC	HV/HRC	D.19
HV	HRC/HV	D.20
HRA	HV/HRA	D.21
HV	HRA/HV	D.22
HR45N	HV/HR45N	D.23
HV	HR45N/HV	D.24
HR30N	HV/HR30N	D.25
HV	HR30N/HV	D.26
HR15N	HV/HR15N	D.27
HV	HR15N/HV	D.28
HRC	HRA/HRC	D.29
HRC	HR30N/HRC	D.30

标准下载站
anystandards.com

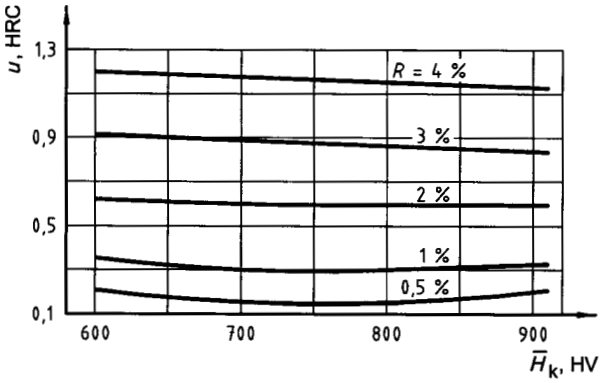


Figure D.1

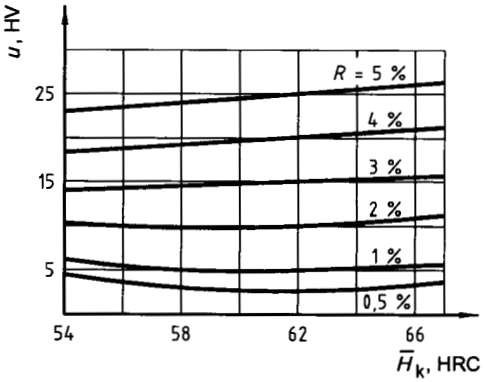


Figure D.2

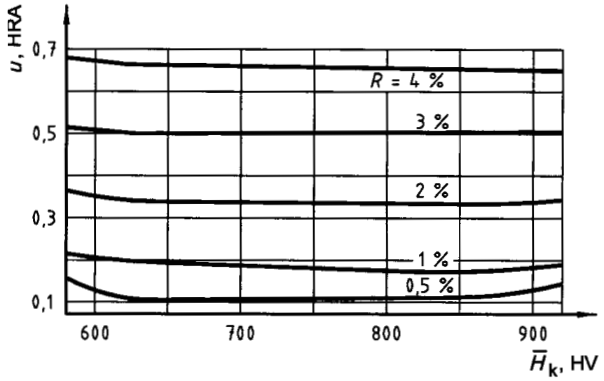


Figure D.3

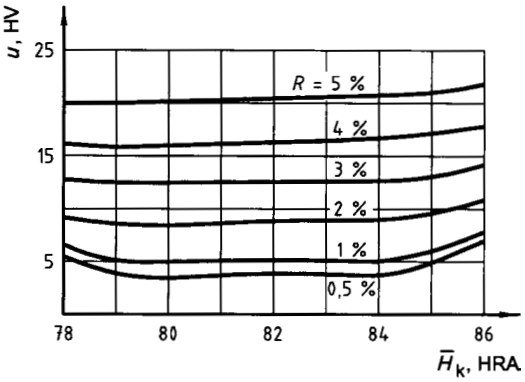


Figure D.4

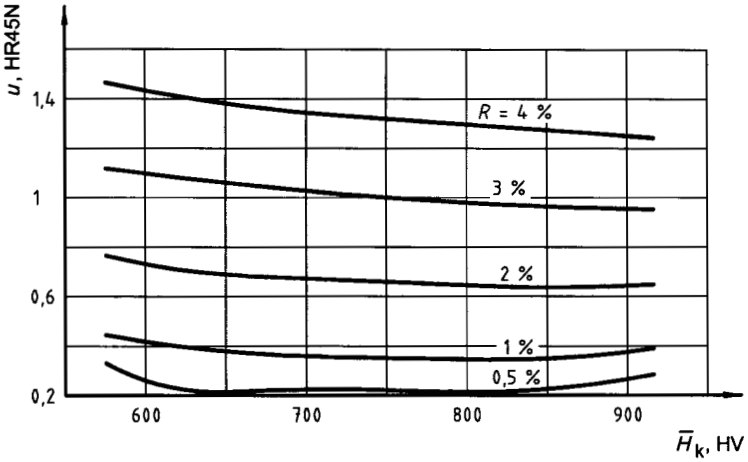


Figure D.5

标准下载站
anystandards.com

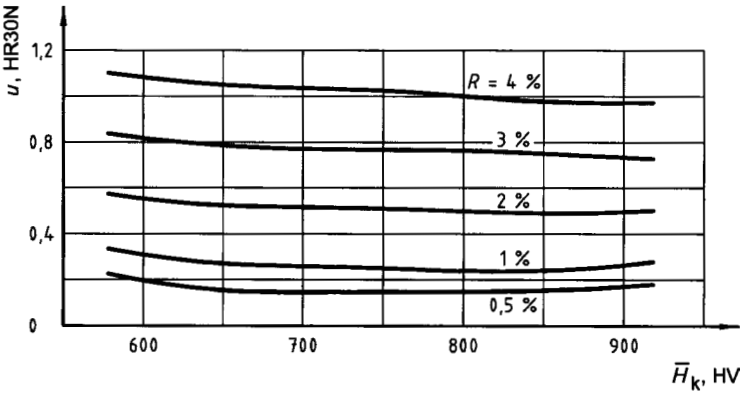


Figure D.6

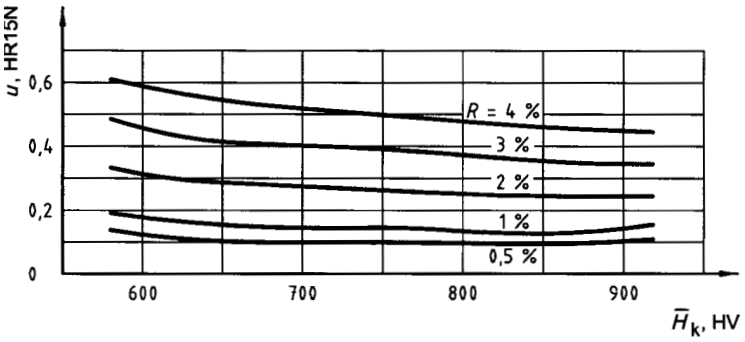


Figure D.7

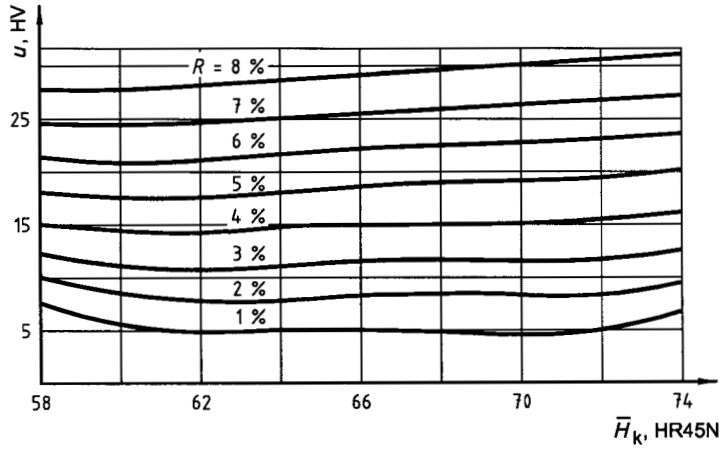


Figure D.8

标准下载站
anystandards.com

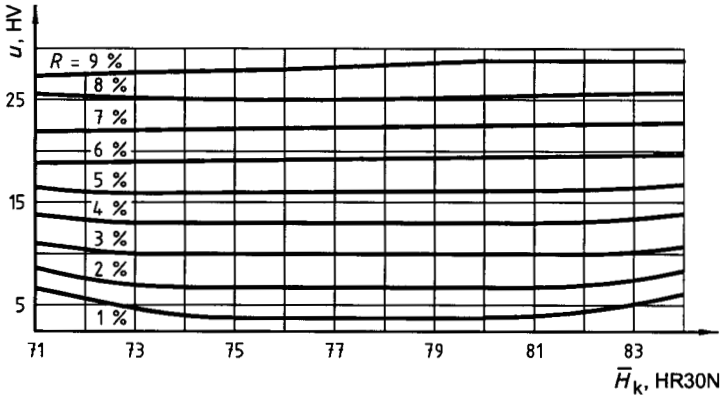


Figure D.9

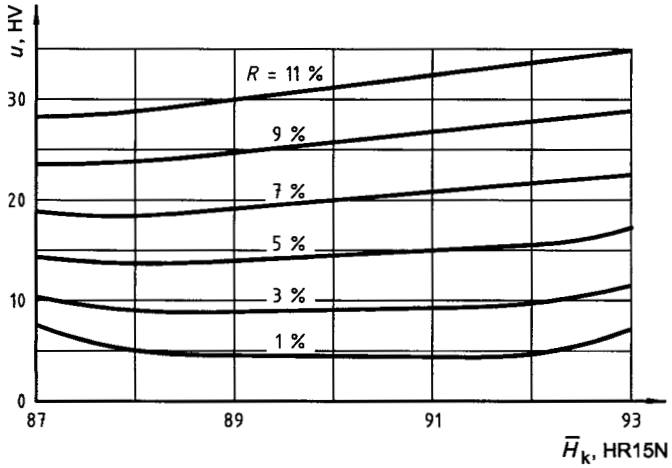


Figure D.10

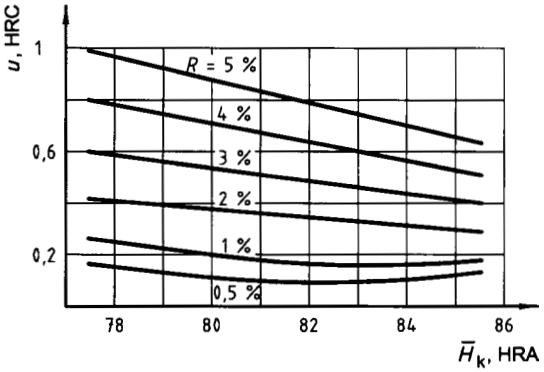


Figure D.11

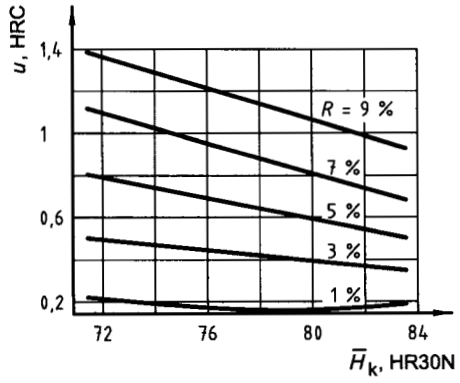


Figure D.12

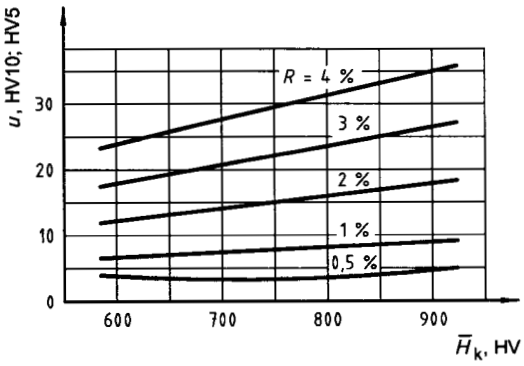


Figure D.13

标准下载站
anystandards.com

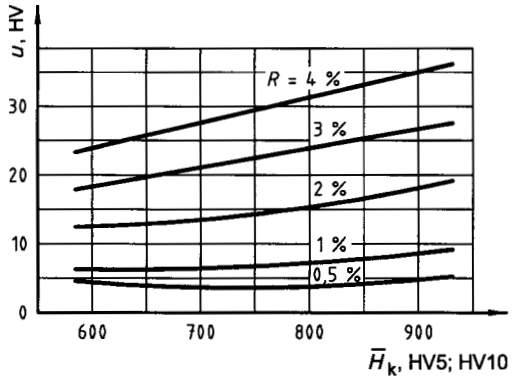


Figure D.14

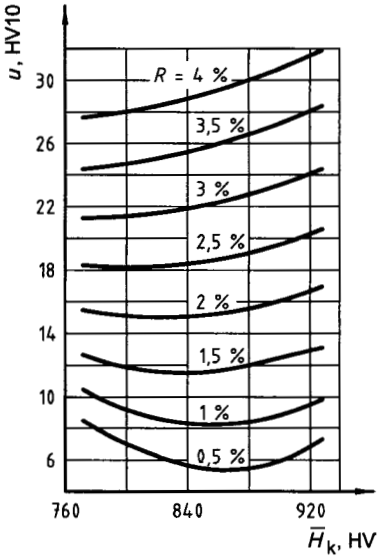


Figure D.15

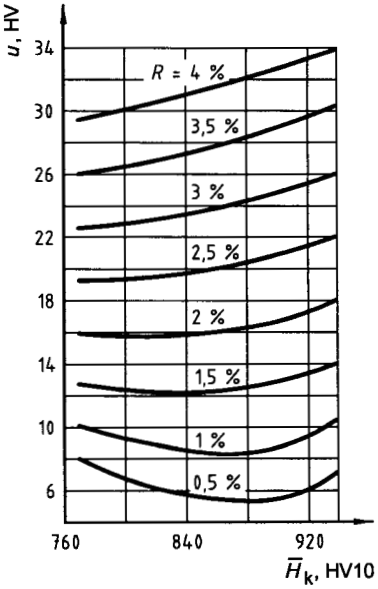


Figure D.16

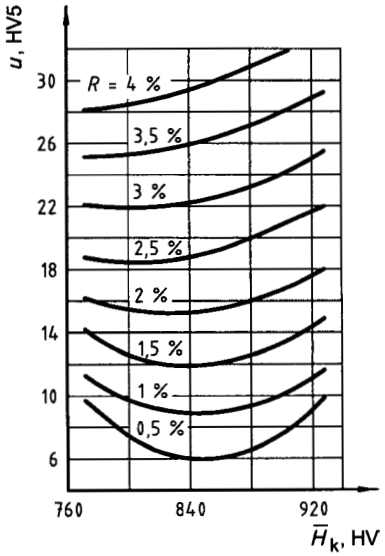


Figure D.17

标准下载站
anystandards.com

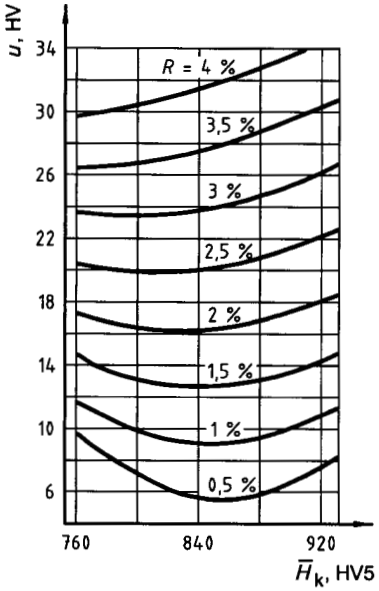


Figure D.18

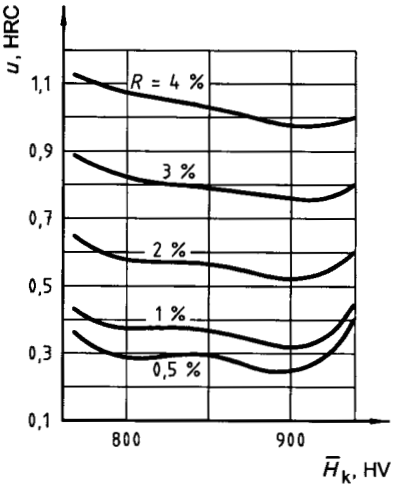


Figure D.19

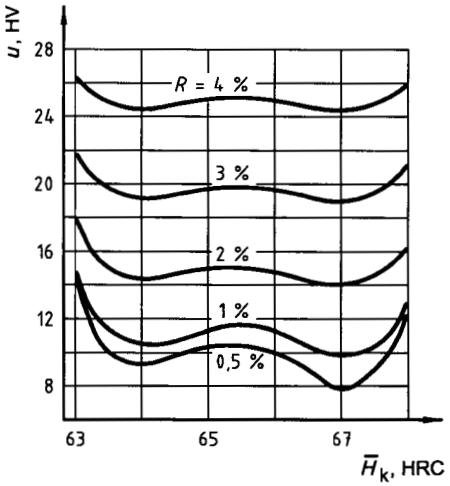


Figure D.20

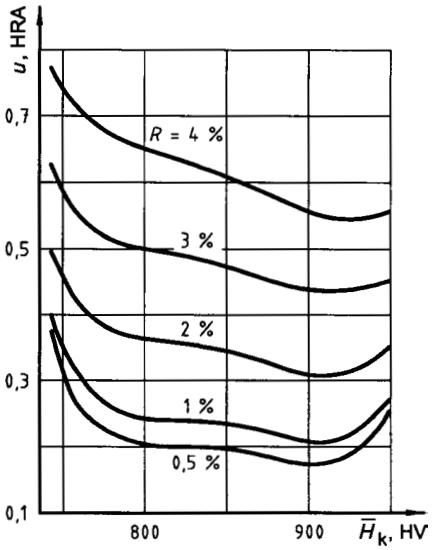


Figure D.21

标准下载站
anystandards.com

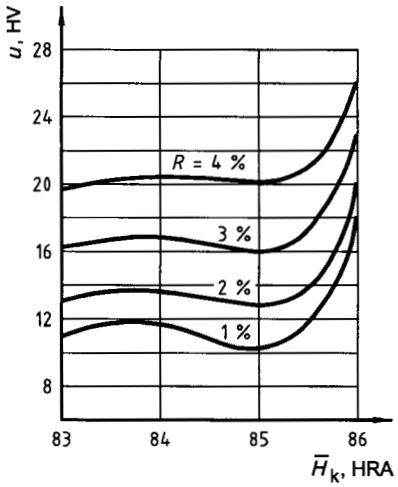


Figure D.22

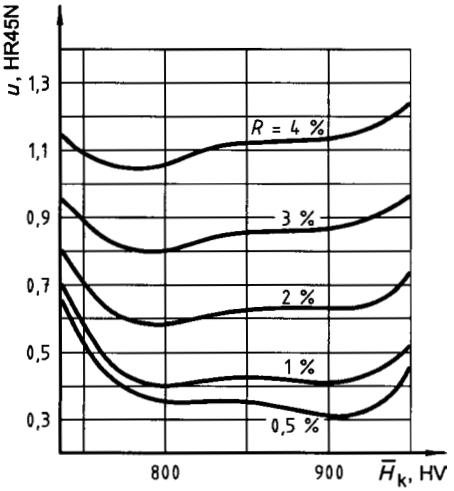


Figure **D.23**

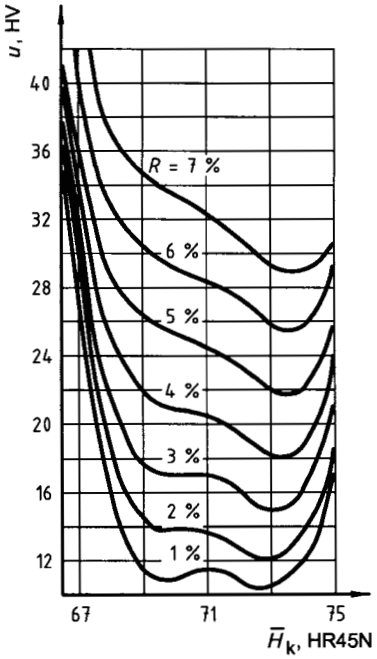


Figure D.24

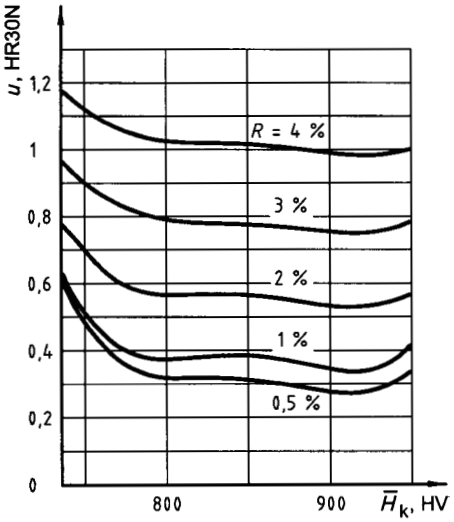


Figure D.25

标准下载站
anystandards.com

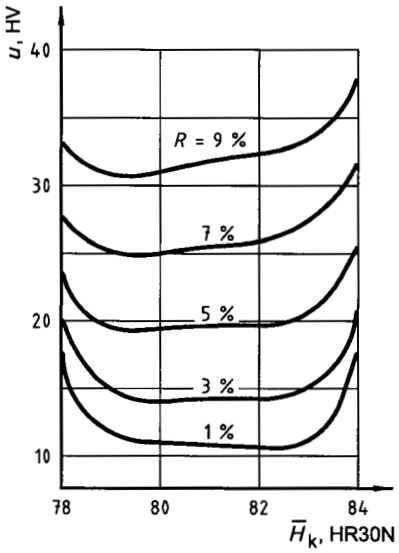


Figure D.26

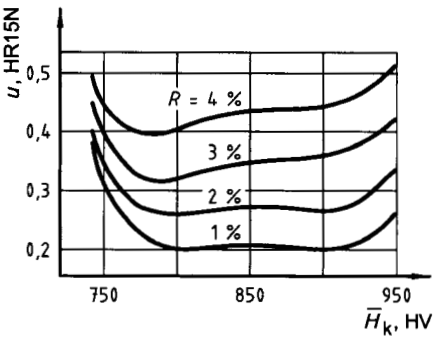


Figure D.27

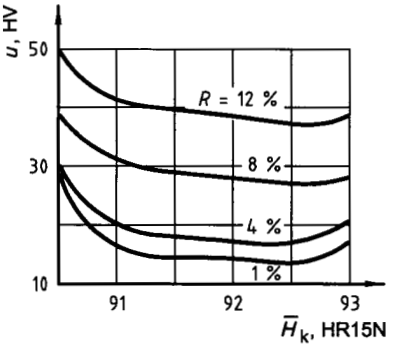


Figure D.28

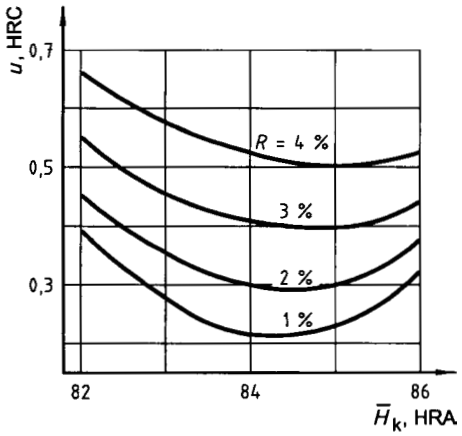


Figure D.29

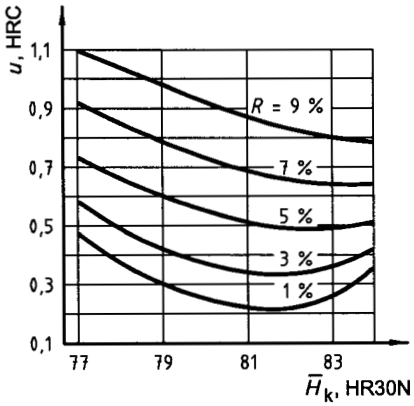


Figure D.30

标准下载站
anystandards.com

Annex E
(informative)

Conversion tables for hardmetals

WARNING — Hardness conversions are no substitute for direct measurements. These tables should be used with caution and only in accordance with the principles of conversions, see Clause 3.

The conversion values presented here for hardmetals are based on results of testing carried out on the hardmetals as in TGL 7965-02, listed in Table E.1. Table E.2 lists the conversion values, whilst Table E.3 gives an overview of the uncertainty curves presented in Figures E.1 and E.2 which are to be used in conjunction with the conversion tables.

NOTE A useful reference book is [24] with information for the comparison of different national and international steel designations with regard to their compositions.

Table E.1 — Designation and chemical composition of hardmetals tested

Hardmetal grade as in TGL 7965-0	**WC content** (% by mass)	**TiC content** (% by mass)	**TaC and NbC** (% by mass)	**Co content** (% by mass)
HS 021	65,8	23,0	8,0	3,2
HS 123	67,3	16,8	7,9	8,0
HS 10	69,0	17,0	8,0	6,0
HS 20	74,0	12,0	6,0	8,0
HS 25	76,0	5,0	10,0	9,0
HS 30	83,0	5,0	5,0	7,0
HS 345	76,9	7,2	7,2	8,7
HS 40	82,0	5,0	4,0	9,0
HS 50	80,0	5,0	3,0	12,0
HG 01	96,0			4,0
HG 110	94,0			6,0
HG 20	94,0			6,0
HG 30	91,5			8,5
HG 40	89,0			11,0
HG 50	85,0			15,0
HG 60	80,0			20,0
HU 10	79,0	10,0	5,0	6,0

标准下载站
anystandards.com

Table E.2 — Conversion from HV 50 values to HRA values of hardmetals

Vickers hardness HV 50	**Rockwell hardness** HRA
780	82,5
800	82,8
820	83,1
840	83,4
860	83,7
880	84,0
900	84,2
920	84,5
940	84,8
960	85,1
980	85,3
1 000	85,6
1 020	85,8
1 040	86,1
1 060	86,4
1 080	86,6
1 100	86,8
1 120	87,1
1 140	87,3
1 160	87,6
1 180	87,8
1 200	88,0
1 220	(88,2)
1 240	(88,4)
1 260	(88,7)
1 280	(88,9)
1 300	(89,1)
1 320	(89,3)
1 340	(89,5)
1 360	(89,7)
1 380	(89,9)
1 400	(90,1)

标准下载站
anystandards.com

Table E.2 (*continued*)

Vickers hardness HV 50	**Rockwell hardness** HRA
1 420	(90,3)
1 440	(90,5)
1 460	(90,7)
1 480	(90,9)
1 500	(91,0)
1 520	(91,2)
1 540	(91,4)
1 560	(91,6)
1 580	(91,8)
1 600	(91,9)
1 620	(92,1)
1 640	(92,3)
1 660	(92,4)
1 680	(92,6)
1 700	(92,8)
1 720	(92,9)
1 740	(93,1)
1 760	(93,2)

NOTE Values in parentheses are those lying outside the defined range of the standard test method but which may be used as estimates.

Table E.3 — Uncertainty curves to be used for conversion as in table E.2

To obtain uncertainty u, in	**of conversion from/to**	**use figure**
HRA	HV/HRA	E.1
HV	HRA/HV	E.2

标准下载站
anystandards.com

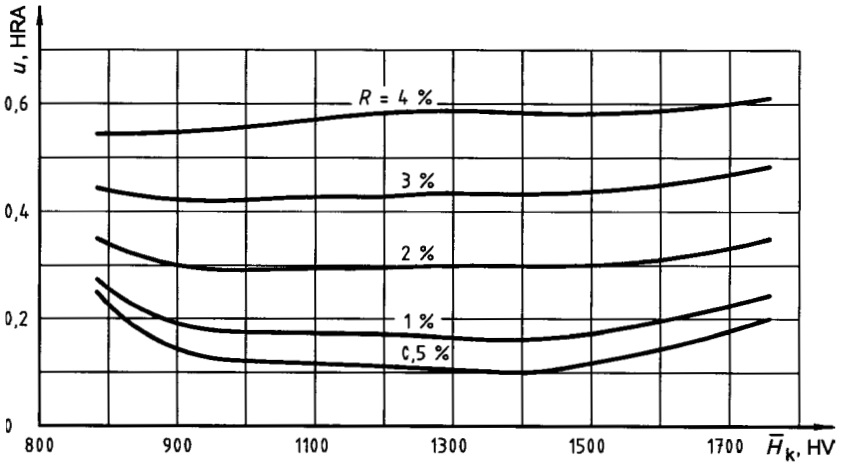


Figure E.1

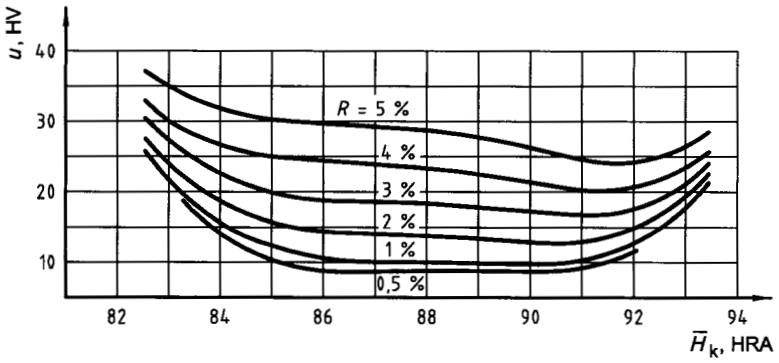


Figure E.2

Annex F
(informative)

Conversion tables for non-ferrous metals and alloys

WARNING — Hardness conversions are no substitute for direct measurements. These tables should be used with caution and only in accordance with the principles of conversions, see Clause 3.

The user of Annex F should consider that the given metals and alloys in most cases are not specified with respect to their composition and treatment conditions.

Table F.1 — Nickel and high-nickel alloys (ASTM E 140-02, Table 3)

HV	HB	Rockwell hardness number														HK
HV1, HV5, HV10,HV30	HBS 10/3 000	HRA	HRB	HRC	HRD	HRE	HRF	HRG	HRK	HR15N	HR30N	HR45N	HR15T	HR30T	HR45T	HK0,5, HK1
513	(479)	75,5	—	50,0	63,0	—	—	—	—	85,5	68,0	54,5	—	—	—	—
481	450	74,5	—	48,0	61,5	—	—	—	—	84,5	66,5	52,5	—	—	—	—
452	425	73,5	—	46,0	60,0	—	—	—	—	83,5	64,5	50,0	—	—	—	—
427	403	72,5	—	44,0	58,5	—	—	—	—	82,5	63,0	47,5	—	—	—	—
404	382	71,5	—	42,0	57,0	—	—	—	—	81,5	61,0	45,5	—	—	—	—
382	363	70,5	—	40,0	55,5	—	—	—	—	80,5	59,5	43,0	—	—	—	436
362	346	69,5	—	38,0	54,0	—	—	—	—	79,5	58,0	41,0	—	—	—	413
344	329	68,5	—	36,0	52,5	—	—	—	—	78,5	56,0	38,5	—	—	—	392
326	313	67,5	—	34,0	50,5	—	—	—	—	77,5	54,5	36,0	—	—	—	372
309	298	66,5	(106)	32,0	49,5	—	(116,5)	94,0	—	76,5	52,5	34,0	94,5	85,5	77,0	352
285	275	64,5	(104)	28,5	46,5	—	(115,5)	91,0	—	75,0	49,5	30,0	94,0	84,5	75,0	325
266	258	63,0	(102)	25,5	44,5	—	(114,5)	87,5	—	73,5	47,0	26,5	93,0	83,0	73,0	304
248	241	61,5	100	22,5	42,0	—	(113,0)	84,5	—	72,0	44,5	23,0	92,5	81,5	71,0	283
234	228	60,5	98	20,0	40,0	—	(112,0)	81,5	—	70,5	42,0	20,0	92,0	80,5	69,0	267
220	215	59,0	96	(17,0)	38,0	—	(111,0)	78,5	100,0	69,0	39,5	17,0	91,0	79,0	67,0	251
209	204	57,5	94	(14,5)	36,0	—	(110,0)	75,5	98,0	68,0	37,5	14,0	90,5	77,5	65,0	239
198	194	56,5	92	(12,0)	34,0	—	(108,5)	72,0	96,5	66,5	35,5	11,0	89,5	76,0	63,0	226
188	184	55,0	90	(9,0)	32,0	(108,5)	(107,5)	69,0	94,5	65,0	32,5	7,5	89,0	75,0	61,0	215
179	176	53,5	88	(6,5)	30,0	(107,0)	(106,5)	65,5	93,0	64,0	30,5	5,0	88,0	73,5	59,5	204
171	168	52,5	86	(4,0)	28,0	(106,0)	(105,0)	62,5	91,0	62,5	28,5	2,0	87,5	72,0	57,5	195
164	161	51,5	84	(2,0)	26,5	(104,5)	(104,0)	59,5	89,0	61,5	26,5	(-0,5)	87,0	70,5	55,5	187
157	155	50,0	82	—	24,5	(103,0)	(103,0)	56,5	87,5	—	—	—	86,0	69,5	53,5	179
151	149	49,0	80	—	22,5	(102,0)	(101,5)	53,0	85,5	—	—	—	85,5	68,0	51,5	173

标准下载站 amystandard.com
Page 60
ISO 18265:2003

标准下载站 anystandards.com

Table F.1 (*continued*)

HV	HB	Rockwell hardness number														HK
HV1, HV5, HV10,HV30	HBS 10/3 000	HRA	HRB	HRC	HRD	HRE	HRF	HRG	HRK	HR15N	HR30N	HR45N	HR15T	HR30T	HR45T	HK0,5, HK1
145	144	47,5	78	—	21.0	(110,5)	(100,5)	50,0	83,5	—	—	—	84,5	66,5	49,5	166
140	139	46,5	76	—	(19,0)	99,5	99,5	47,0	82,0	—	—	—	84,0	65,5	47,5	160
135	134	45,5	74	—	(17,5)	98,0	98,5	43,5	80,0	—	—	—	83,0	64,0	45,5	154
130	129	44,0	72	—	(16,0)	97,0	97,0	40,5	78,0	—	—	—	82,5	62,5	43,5	149
126	125	43,0	70	—	(14,5)	95,5	96,0	37,5	76,5	—	—	—	82,0	61,0	41,5	144
122	121	42,0	68	—	(13,0)	94,5	95,0	34,5	74,5	—	—	—	81,0	60,0	39,5	140
119	118	41,0	66	—	(11,5)	93,0	93,5	31,0	72,5	—	—	—	80,5	58,5	37,5	136
115	114	40,0	64	—	(10,0)	91,5	92,5	—	71,0	—	—	—	79,5	57,0	35,5	—
112	111	39,0	62	—	(8,0)	90,5	91,5	—	69,0	—	—	—	79,0	56,0	33,5	—
108	108	—	60	—	—	89,0	90,0	—	67,5	—	—	—	78,5	54,5	31,5	—
106	106	—	58	—	—	88,0	89,0	—	65,5	—	—	—	77,5	53,0	29,5	—
103	103	—	56	—	—	86,5	88,0	—	63,5	—	—	—	77,0	51,5	27,5	—
100	100	—	54	—	—	85,5	87,0	—	62,0	—	—	—	76,0	50,5	25,5	—
98	98	—	52	—	—	84,0	85,5	—	60,0	—	—	—	75,5	49,0	23,5	—
95	95	—	50	—	—	83,0	84,5	—	58,0	—	—	—	74,5	47,5	21,5	—
93	93	—	48	—	—	81,5	83,5	—	56,5	—	—	—	74,0	46,5	19,5	—
91	91	—	46	—	—	80,5	82,0	—	54,5	—	—	—	73,5	45,0	17,0	—
89	89	—	44	—	—	79,0	81,0	—	52,5	—	—	—	72,5	43,5	14,5	—
87	87	—	42	—	—	78,0	80,0	—	51,0	—	—	—	72,0	42,0	12,5	—
85	85	—	40	—	—	76,5	79,0	—	49,0	—	—	—	71,0	41,0	10,0	—
83	83	—	38	—	—	75,0	77,5	—	47,0	—	—	—	70,5	39,5	7,5	—
81	81	—	36	—	—	74,0	76,5	—	45,5	—	—	—	70,0	38,0	5,5	—

Table F.1 (*continued*)

HV	HB	Rockwell hardness number														HK
HV1, HV5, HV10,HV30	HBS 10/3 000	HRA	HRB	HRC	HRD	HRE	HRF	HRG	HRK	HR15N	HR30N	HR45N	HR15T	HR30T	HR45T	HK0,5, HK1
79	79	—	34	—	—	72,5	75,5	—	43,5	—	—	—	69,0	36,5	3,0	—
78	78	—	32	—	—	71,5	74,0	—	42,0	—	—	—	68,5	35,5	1,0	—
77	77	—	30	—	—	70,0	73,0	—	40,0	—	—	—	67,5	34,0	(-1,5)	—

NOTE The use of hardness scales for hardness values shown in parentheses is not recommended since they are beyond the ranges recommended for accuracy. Such values are shown for comparative purposes only, where comparisons may be desired and the recommended machine and scale are not available.

标准分享网 www.bzfxw.com 免费下载
Page 52 of ISO 18265:2003
anystandards.com

标准下载站 anystandards.com

Table F.2 — Cartridge brass (70 % copper 30 % zinc alloy) (ASTM E 140-02, Table 4)

HV	Rockwell hardness number					HB
	HRB	HRF	HR15T	HR30T	HR45T	HBS10/500
196	93,5	110,0	90.0	77,5	66,0	169
194	—	109,5	—	—	65,5	167
192	93,0	—	—	77,0	65,0	166
190	92,5	109,0	—	76,5	64,5	164
188	92,0	—	89,5	—	64,0	162
186	91,5	108,5	—	76,0	63,5	161
184	91,0	—	—	75,5	63,0	159
182	90,5	108,0	89,0	—	62,5	157
180	90,0	107,5	—	74,5	62,0	156
178	89,0	—	—	—	61,5	154
176	88,5	107,0	—	—	61,0	152
174	88,0	—	88,5	74,0	60,5	150
172	87,5	106,5	—	73,5	60,0	149
170	87,0	—	—	—	59,5	147
168	86,0	106,0	88,0	73,0	59,0	146
166	85,5	—	—	72,5	58,5	144
164	85,0	105,5	—	72,0	58,0	142
162	84,0	105,0	87,5	—	57,5	141
160	83,5	—	—	71,5	56,5	139
158	83,0	104,5	—	71,0	56,0	138
156	82,0	104,0	87,0	70,5	55,5	136
154	81,5	103,5	—	70,0	54,5	135
152	80,5	103,0	—	—	54,0	133
150	80,0	—	86,5	69,5	53,5	131

标准下载站
anystandards.com

Table F.2 (*continued*)

HV	Rockwell hardness number					HB
	HRB	HRF	HR15T	HR30T	HR45T	HBS10/500
148	79,0	102,5	—	69,0	53,0	129
146	78,0	102,0	—	68,5	52,5	128
144	77,5	101,5	86,0	68,0	51,5	126
142	77,0	101,0	—	67,5	51,0	124
140	76,0	100,5	85,5	67,0	50,0	122
138	75,0	100,0	—	66,5	49,0	121
136	74,5	99,5	85,0	66,0	48,0	120
134	73,5	99,0	—	65,5	47,5	118
132	73,0	98,5	84,5	65,0	46,5	116
130	72,0	98,0	84,0	64,5	45,5	114
128	71,0	97,5	—	63,5	45,0	113
126	70,0	97,0	83,5	63,0	44,0	112
124	69,0	96,5	—	62,5	43,0	110
122	68,0	96,0	83,0	62,0	42,0	108
120	67,0	95,5	—	61,0	41,0	106
118	66,0	95,0	82,5	60,5	40,0	105
116	65,0	94,5	82,0	60,0	39,0	103
114	64,0	94,0	81,5	59,5	38,0	101
112	63,0	93,0	81,0	58,5	37,0	99
110	62,0	92,6	80,5	58,0	35,5	97
108	61,0	92,0	—	57,0	34,5	95
106	59,5	91,2	80,0	56,0	33,0	94
104	58,0	90,5	79,5	55,0	32,0	92
102	57,0	89,8	79,0	54,5	30,5	90
100	56,0	89,0	78,5	53,5	29,5	88

标准下载站 anystandards.com

Table F.2 (*continued*)

HV	Rockwell hardness number					HB
	HRB	HRF	HR15T	HR30T	HR45T	HBS10/500
98	54,0	88,0	78,0	52,5	28,0	86
96	53,0	87,2	77,5	51,5	26,5	85
94	51,0	86,3	77,0	50,5	24,5	83
92	49,5	85,4	76,5	49,0	23,0	82
90	47,5	84,4	75,5	48,0	21,0	80
88	46,0	83,5	75,0	47,0	19,0	79
86	44,0	82,3	74,5	45,5	17,0	77
84	42,0	81,2	73,5	44,0	14,5	76
82	40,0	80,0	73,0	43,0	12,5	74
80	37,5	78,6	72,0	41,0	10,0	72
78	35,0	77,4	71,5	39,5	7,5	70
76	32,5	76,0	70,5	38,0	4,5	68
74	30,0	74,8	70,0	36,0	1,0	66
72	27,5	73,2	69,0	34,0	—	64
70	24,5	71,8	68,0	32,0	—	63
68	21,5	70,0	67,0	30,0	—	62
66	18,5	68,5	66,0	26,0	—	61
64	15,5	66,8	65,0	25,5	—	59
62	12,5	65,0	63,5	23,0	—	57
60	10,0	62,5	62,5	—	—	55
58	—	61,0	61,0	18,0	—	53
56	—	58,8	60,0	15,0	—	52
54	—	56,5	58,5	12,0	—	50
52	—	53,5	57,0	—	—	48

Table F.2 (*continued*)

HV	Rockwell hardness number					HB
	HRB	HRF	HR15T	HR30T	HR45T	HBS10/500
50	—	50,5	55,5	—	—	47
48	—	49,0	54,5	—	—	46
47	—	47,0	53,5	—	—	45
46	—	45,0	—	—	—	44
45	—	40,0	—	—	—	42

Page 66 下载站
标准 EN ISO 18265:2003
amystandard.com

Table F.3 — Copper (ASTM E 140-02, Table 7)

Vickers hardness number		Knoop hardness number		Rockwell hardness number								Brinell hardness number	
HV1	HV0,1	HK1	HK0,5	HR15T	HR15T	HR30T	HRB	HRF	HR15T	HR30T	HR45T	HBS 10/500	HBS 2/20
				Strip 0,25 mm	Strip 0,51 mm			Strip 1,02 mm and greater				Strip 2,03 mm	Strip 1,02 mm
130	127,0	138,7	133,8	—	85,0	—	67,0	99,0	—	69,5	49,0	—	119,0
128	125,2	136,8	132,1	83,0	84,5	—	66,0	98,0	87,0	68,5	48,0	—	117,5
126	123,6	134,9	130,4	—	84,0	—	65,0	97,0	—	67,5	46,5	120,0	115,0
124	121,9	133,0	128,7	82,5	83,5	—	64,0	96,0	86,0	66,5	45,0	117,5	113,0
122	121,1	131,0	127,0	—	83,0	—	62,5	95,5	85,5	66,0	44,0	115,0	111,0
120	118,5	129,0	125,2	82,0	82,5	—	61,0	95,0	—	65,0	42,5	112,0	109,0
118	116,8	127,1	123,5	81,5	—	—	59,5	94,0	85,0	64,0	41,0	110,0	107,5
116	115,0	125,1	121,7	—	82,0	—	58,5	93,0	—	63,0	40,0	107,0	105,5
114	113,5	123,2	119,9	81,0	81,5	—	57,0	92,5	84,5	62,0	38,5	105,0	103,5
112	111,8	121,4	118,1	80,5	81,0	—	55,0	91,5	—	61,0	37,0	102,0	102,0
110	109,9	119,5	116,3	80,0	—	—	53,5	91,0	84,0	60,0	36,0	99,5	100,0
108	108,3	117,5	114,5	—	80,5	—	52,0	90,5	83,5	59,0	34,5	97,0	98,0
106	106,6	115,6	112,6	79,5	80,0	—	50,0	89,5	—	58,0	33,0	94,5	96,0
104	104,9	113,5	110,1	79,0	79,5	—	48,0	88,5	83,0	57,0	32,0	92,0	94,0
102	103,2	111,5	108,0	78,5	79,0	—	46,5	87,5	82,5	56,0	30,0	89,5	92,0
100	101,5	109,4	106,0	78,0	78,0	—	44,5	87,0	82,0	55,0	28,5	87,0	90,0
98	99,8	107,3	104,0	77,5	77,5	—	42,0	85,5	81,0	53,5	26,5	84,5	88,0
96	98,0	105,3	102,1	77,0	77,0	—	40,0	84,5	80,5	52,0	25,5	82,0	86,6
94	96,4	103,2	100,0	76,5	76,5	—	38,0	83,0	80,0	51,0	23,0	79,5	85,0
92	94,7	101,0	98,0	76,0	75,5	—	35,5	82,0	79,0	49,0	21,0	77,0	83,0
90	93,0	98,9	96,0	75,5	75,0	—	33,0	81,0	78,0	47,5	19,0	74,5	81,0
88	91,2	96,9	94,0	75,0	74,5	—	30,5	79,5	77,0	46,0	16,5	—	79,0
86	89,7	95,5	92,0	74,5	73,5	—	28,0	78,0	76,0	44,0	14,0	—	77,0

标准下载站 anystandards.com

Table F.3 (*continued*)

Vickers hardness number		Knoop hardness number		Rockwell hardness number								Brinell hardness number	
HV1	HV0,1	HK1	HK0,5	HR15T	HR15T	HR30T	HRB	HRF	HR15T	HR30T	HR45T	HBS 10/500	HBS 2/20
				Strip 0,25 mm	Strip 0,51 mm			Strip 1,02 mm and greater				Strip 2,03 mm	Strip 1,02 mm
84	87,9	92,3	90,0	74,0	73,0	—	25,5	76,5	75,0	43,0	12,0	—	75,0
82	86,1	90,1	87,9	73,5	72,0	—	23,0	74,5	74,5	41,0	9,5	—	73,0
80	84,5	87,9	86,0	72,5	71,0	—	20,0	73,0	73,5	39,5	7,0	—	71,5
78	82,8	85,7	84,0	72,0	70,0	—	17,0	71,0	72,5	37,5	6,0	—	69,5
76	81,0	83,5	81,9	71,5	69,5	—	14,5	69,0	71,5	36,0	2,0	—	67,5
74	79,2	81,1	79,9	71,0	68,5	—	11,5	67,5	70,0	34,0	—	—	66,0
72	77,6	78,9	78,7	70,0	67,5	—	8,5	66,0	69,0	32,0	—	—	64,0
70	75,8	76,8	76,6	69,5	66,5	—	5,0	64,0	67,5	30,0	—	—	62,0
68	74,3	74,1	74,4	69,0	65,5	—	2,0	62,0	66,0	28,0	—	—	60,5
66	72,6	71,9	71,9	68,0	64,5	—	—	60,0	64,5	25,5	—	—	58,5
64	70,9	69,5	70,0	67,5	63,5	—	—	58,0	63,5	23,5	—	—	57,0
62	69,1	67,0	67,9	66,5	62,0	—	—	56,0	61,0	21,0	—	—	55,0
60	67,5	64,6	65,9	66,0	61,0	—	—	54,0	59,0	18,0	—	—	53,0
58	65,8	62,0	63,8	65,0	60,0	—	—	51,5	57,0	15,5	—	—	51,5
56	64,0	59,8	61,8	64,5	58,5	—	—	49,0	55,0	13,0	—	—	49,5
54	62,3	57,4	59,5	63,5	57,5	—	—	47,0	53,0	10,0	—	—	48,0
52	60,7	55,0	57,2	63,0	56,0	—	—	44,0	51,5	7,5	—	—	46,5
50	58,9	52,8	55,0	62,0	55,0	—	—	41,5	49,5	4,5	—	—	44,5
48	57,3	50,3	52,7	61,0	53,5	—	—	39,0	47,5	1,5	—	—	42,0
46	55,8	48,0	50,2	60,5	52,0	—	—	36,0	45,0	—	—	—	41,0
44	53,9	45,9	47,8	59,5	51,0	—	—	33,5	43,0	—	—	—	—
42	52,2	43,7	45,2	58,5	49,5	—	—	30,5	41,0	—	—	—	—
40	51,3	40,2	42,8	57,5	48,0	—	—	28,0	38,5	—	—	—	—

Page 68
标准分享网 www.bzfxw.com 免费下载
anystandards.com
ISO 18265:2003

标准下载站
anystandards.com

Table F.4 — Wrought aluminium products (ASTM E 140-02, Table 9)

HBS10/500	HV15	Rockwell hardness number					
		HRB	HRE	HRH	HR15T	HR30T	HR15N
160	189	91	—	—	89	77	95
155	183	90	—	—	89	76	95
150	177	89	—	—	89	75	94
145	171	87	—	—	88	74	94
140	165	86	—	—	88	73	94
135	159	84	—	—	87	71	93
130	153	81	—	—	87		
125	147	79	—	—	86	68	92
120	141	76	—	—	86	67	92
115	135	72	101	—	86	65	91
110	129	69	100	—	85	63	91
105	123	65	99	—	84	61	91
100	117	60	98	—	83	59	90
95	111	56	96	—	82	57	90
90	105	51	94	108	81	54	89
85	98	46	91	107	80	52	89
80	92	40	88	106	78	50	88
75	86	34	84	104	76	47	87
70	80	28	80	102	74	44	86
65	74	—	75	100	72	—	85
60	68	—	70	97	70	—	83
55	62	—	65	94	67	—	82
50	56	—	59	91	64	—	80
45	50	—	53	87	62	—	79
40	44	—	46	83	59	—	77

标准下载站
anystandards.com

Table F.5 — Aluminium and its alloys (BS 860:1967, Table 1)

HV10	HB (F/D^2 = 5 or 10)	HRB
210	199,5	95,7
205	194,8	94,8
200	190,0	93,8
195	185,3	92,7
190	180,5	91,6
185	175,8	90,4
180	171,0	89,2
175	166,3	87,9
170	161,5	86,5
165	156,8	85,0
160	152,0	83,4
155	147,3	81,8
150	142,5	80,0
145	137,8	78,1
140	133,0	76,1
135	128,3	73,9
130	123,5	71,5
125	118,8	69,0
120	114,0	66,3
115	109,3	63,3
110	104,5	60,0
105	99,8	56,4
100	95,0	52,5
98	93,1	50,8
96	91,2	49,1
94	89,3	47,2
92	87,4	45,3
90	85,5	43,3
88	83,6	41,3
86	81,7	39,1
84	79,8	36,8
82	77,9	34,4
80	76,0	31,9

标准下载站
anystandards.com

Table F.5 (*continued*)

HV10	HB (F/D^2 = 5 or 10)	HRB
78	74,1	—
76	72,2	—
74	70,3	—
72	68,4	—
70	66,5	—
68	64,6	—
66	62,7	—
64	60,8	—
62	58,9	—
60	57,0	—
58	55,1	—
56	53,2	—
54	51,3	—
52	49,4	—
50	47,5	—
48	45,6	—
46	43,7	—
44	41,8	—
42	39,9	—
40	38,0	—
38	36,1	—
36	34,2	—
34	32,3	—
32	30,4	—
30	28,5	—
28	26,6	—
26	24,7	—
24	22,8	—
22	20,9	—
20	19,0	—
18	17,1	—

标准下载站
anystandards.com

Bibliography

[1] ECKHART, H. and OTTO, M., *Vergleichswerte Härte/Zugfestigkeit und Härtevergleichstabellen für Vergütungsstähle*, PTB-Bericht, PTB-F-10, February 1992

[2] SCHMIDT, W., *Vorsicht bei der Bewertung des Werkstoffverhaltens mit Hilfe nichtgenormter Härteprüfverfahren*, Z. Draht 46 (1995) 5, p. 255

[3] SCHMIDT, W., *Betrachtungen zur Umwertung von Härtewerten*, VDI-Berichte No. 1194, 1995

[4] HAHN, F., *Die Prüfung der Festigkeit harter Stähle im Zugversuch*, Disseration TU Berlin 1968

[5] TGL 4393, *Kaltarbeitsstähle, legiert, gewalzt, geschmiedet, gezogen*

[6] TGL 7571, *Schnellarbeitsstähle, geschmiedet, warm gewalzt, gezogen*

[7] TGL 6547, *Vergütungsstähle, Technische Bedingungen für Stabstahl, warmgewalzt und Freiformschmiedestücke*

[8] TGL 7975, *Bandstahl*

[9] TGL 7965-02, *Gesinterte Hartmetalle, Sorten, Anwendung*

[10] ISO 4957:1999, *Tool steels*

[11] DIN 17200:1987[2)], *Vergütungsstähle — Technische Lieferbedingungen*

[12] EN 10083-1:1991, *Quenched and tempered steels — Part 1: Technical delivery conditions for stainless steels* (includes Amendment A1:1996)

[13] TGL 43212-01, *Metalle, Härtevergleichswerte, Allgemeine Festlegungen*

[14] TGL 43212-02, *Metalle, Härtevergleichswerte, Hartmetalle*

[15] TGL 43212-03, *Metalle, Härtevergleichswerte, Kaltarbeitsstähle*

[16] TGL 43212-04, *Metalle, Härtevergleichswerte, Schnellarbeitsstähle*

[17] ISO 4964, *Steel — Hardness conversions*

[18] ISO/TR 10108, *Steel — Conversion of hardness values to tensile strength values*

[19] Mitteilung Nr. 3:1980-03, *Vergleichszahlen für Härtewerte bei Stahl* (Europäische Gemeinschaft für Kohle und Stahl)

[20] Mitteilung Nr. 4:1982-03, *Umwertung von Härte (HB + HV) und Zugfestigkeit bei Stahl* (Europäische Gemeinschaft für Kohle und Stahl)

[21] OTTO, M., *Umwertung von Härtewerten*, Tagungsband der Tagung Werkstoffprüfung 1999, DVM, Berlin

---

2) Withdrawn and replaced by EN 10083-1.

标准下载站
anystandards.com

[22] ASTM E 140-02, *Standard Hardness Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, and Scleroscope Hardness*

[23] BS 860:1967, *Tables for comparison of hardness scales*

[24] *Stahlschlüssel (Key to Steel)*, Verlag Stahlschlüssel Wegst GmbH, 10th Edition 2001, ISBN 3-922599-17-6

Annex ZA
(normative)

Normative references to international publications with their relevant European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

NOTE Where an International Publication has been modified by common modifications, indicated by (mod.), the relevant EN/HD applies.

Publication	Year	Title	EN	Year
ISO 6506-1	1999	Metallic materials - Brinell hardness test - Part 1: Test method	EN ISO 6506-1	1999
ISO 6507-1	1997	Metallic materials - Vickers hardness test - Part 1: Test method	EN ISO 6507-1	1997
ISO 6507-2	1997	Metallic materials - Vickers hardness test - Part 2: Verification of testing machines	EN ISO 6507-2	1997
ISO 6508-1	1999	Metallic materials - Rockwell hardness test - Part 1: Test method (scales A, B, C, D, E, F, G, H, K, N, T)	EN ISO 6508-1	1999
ISO 6508-2	1999	Metallic materials - Rockwell hardness test - Part 2: Verification and calibration of testing machines (scales A, B, C, D, E, F, G, H, K, N, T)	EN ISO 6508-2	1999
ISO 7500-1	1999	Metallic materials - Verification of static uniaxial testing machines - Part 1: Tension/compression testing machines	EN ISO 7500-1	1999
ISO 9513	1999	Metallic materials - calibration of extensometers used in uniaxial testing	EN ISO 9513	2002