

TECHNICAL REPORT

ISO/TR 10108

First edition
1989-09-01

Steel — Conversion of hardness values to tensile strength values

Acier — Valeurs de conversion de la dureté à la résistance à la traction

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The main task of ISO technical committees is to prepare International Standards. In exceptional circumstances a technical committee may propose the publication of a technical report of one of the following types:

- type 1, when the necessary support within the technical committee cannot be obtained for the publication of an International Standard, despite repeated efforts;
- type 2, when the subject is still under technical development requiring wider exposure;
- type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example).

Technical reports are accepted for publication directly by ISO Council. Technical reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

ISO/TR 10108, which is a technical report of type 2, was prepared by Technical Committee ISO/TC 17, *Steel*.

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Introduction

SC 20 agreed to take as a basis for discussion the European Information Circular No. 4 because the scatter bands covered in this document, and now incorporated into this Technical Report, stemmed from a large number of technical results and provided the most reliable information for the totality of steels.

SC 20 also agreed not to insert the mean curves of the scatter bands in figures 1 and 2, as it wanted to avoid the impression that the same correlation between hardness and tensile strength is applicable to all steel groups and treatment conditions. Additionally, there were certain doubts as to whether figures 1 and 2 reflect sufficiently exactly the reality for austenitic steels which are solution-treated and not subsequently work-hardened.

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Nevertheless, it was decided that it would be useful to publish the scatter bands in the form of a type 2 Technical Report.

Users of this Technical Report are requested to send any relevant data, in particular, data which can identify specific hardness-tensile relationships for particular steel groupings to enable the presentation of more detailed information here, to the Secretariat of ISO/TC 17/SC 20:

BSI
3 York Street
Manchester M2 2AT
England.

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Steel — Conversion of hardness values to tensile strength values

1 Scope

This Technical Report describes the hardness to tensile strength conversion bands, established for the Brinell and Vickers hardness scales, and the rules for using them.

The conversion bands defined here apply to all steels but only to solid products (thicker than 2 mm) of homogeneous structure that have not been work-hardened.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Technical Report. At the time of publication the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this Technical Report are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 6506 : 1981, *Metallic materials — Hardness test — Brinell test*.

ISO 6507-1 : 1982, *Metallic materials — Hardness test — Vickers test — Part 1: HV 5 to HV 100*.

ISO 6892 : 1984, *Metallic materials — Tensile testing*.

3 Principle of conversion bands

The conversion bands have been established on the basis of results obtained by various laboratories from a very large number of hardness tests carried out on the ends of tensile test

pieces used to determine tensile strength for a wide range of steels. These test results have been processed by conventional statistical methods to establish 95 % confidence limits.

NOTE — The steel grades examined were as follows : extra-mild steels, mild steels, structural steels, high-strength steels, very high-strength steels, alloy steels and stainless steels. The steels were in the normal as-delivered states (as-rolled, normalized, annealed, quenched and tempered).

The Brinell and Vickers hardness tests and the tensile test were carried out in accordance with ISO 6506, ISO 6507-1 and ISO 6892 respectively.

Figure 1 gives the Brinell hardness — tensile strength conversion band; figure 2 gives the Vickers hardness — tensile strength conversion band.

Tables 1 and 2 give the limit values of the scatter band of the hardness — tensile strength conversion values.

4 Conditions for use

The tensile strength values obtained by conversion can under no circumstances replace the values specified in product standards and their use does not obviate the need to carry out the tensile test.

They are not to be regarded as grounds for complaint.

The conversion values defined in this Technical Report may be used only to determine the order of magnitude of tensile strength.

NOTE — In special cases a correlation specific to a type of product may be established.

Table 1 — Brinell hardness—tensile strength conversion

Limit values of the scatter band (95 % confidence limit)

Brinell hardness HBS or HBW	Minimum tensile strength $R_{m, \min}$ N/mm ² 1)	Maximum tensile strength $R_{m, \max}$ N/mm ² 1)	Brinell hardness HBS or HBW	Minimum tensile strength $R_{m, \min}$ N/mm ² 1)	Maximum tensile strength $R_{m, \max}$ N/mm ² 1)
85	270	470	285	860	1 060
90	280	480	290	880	1 080
95	290	490	295	890	1 090
100	310	510	300	910	1 110
105	320	520	310	950	1 150
110	330	530	320	980	1 180
115	350	550	330	1 020	1 220
120	360	560	340	1 050	1 250
125	370	570	350	1 090	1 290
130	390	590	360	1 120	1 320
135	400	600	370	1 160	1 360
140	410	610	380	1 200	1 400
145	430	630	390	1 240	1 440
150	440	640	400	1 270	1 470
155	460	660	410	1 310	1 510
160	470	670	420	1 350	1 550
165	490	690	430	1 390	1 590
170	500	700	440	1 430	1 630
175	510	710	450	1 470	1 670
180	530	730	460	1 510	1 710
185	540	740	470	1 550	1 750
190	560	760	480	1 590	1 790
195	570	770	490	1 630	1 830
200	590	790	500	1 680	1 880
205	600	800	510	1 720	1 920
210	620	820	520	1 760	1 960
215	630	830	530	1 800	2 000
220	650	850	540	1 850	2 050
225	670	870	550	1 890	2 090
230	680	880	560	1 940	2 140
235	700	900	570	1 980	2 180
240	710	910	580	2 030	2 230
245	730	930	590	2 070	2 270
250	750	950	600	2 120	2 320
255	760	960	610	2 160	2 360
260	780	980	620	2 210	2 410
265	790	990	630	2 260	2 460
270	810	1 010	640	2 310	2 510
275	830	1 030	650	2 350	2 550
280	840	1 040			

1) 1 N/mm² = 1 MPa

NOTE — The tensile strength values obtained by conversion can under no circumstances replace the values specified in product standards and their use does not obviate the need to carry out the tensile test.

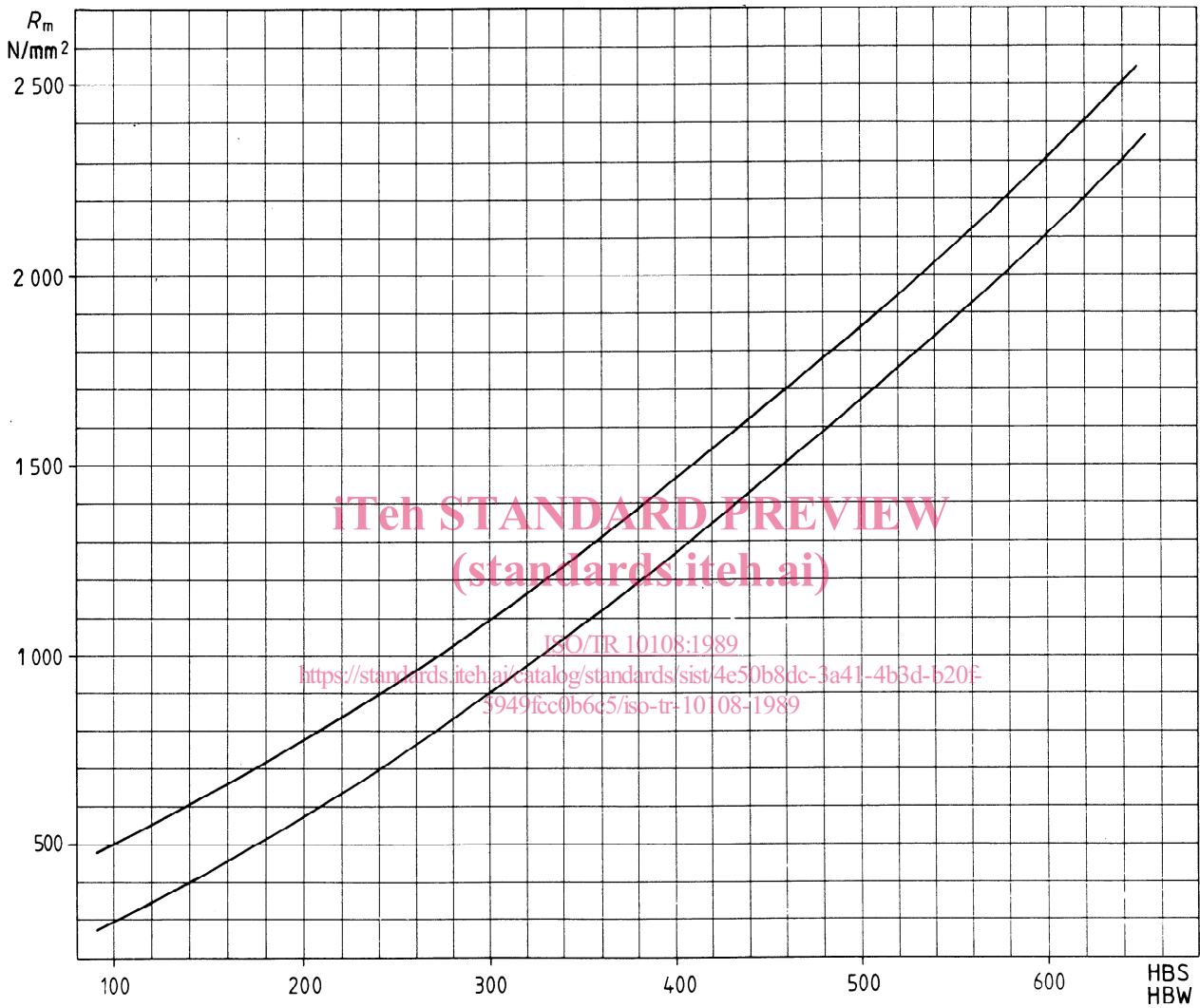
Table 2 — Vickers hardness—tensile strength conversion

Limit values of the scatter band (95 % confidence limit)

Vickers hardness HV	Minimum tensile strength $R_{m, min}$ N/mm ² 1)	Maximum tensile strength $R_{m, max}$ N/mm ² 1)	Vickers hardness HV	Minimum tensile strength $R_{m, min}$ N/mm ² 1)	Maximum tensile strength $R_{m, max}$ N/mm ² 1)
85	200	420	285	800	1 020
90	220	430	290	820	1 030
95	230	440	295	840	1 050
100	240	460	300	850	1 070
105	260	470	310	880	1 100
110	270	490	320	920	1 130
115	290	500	330	950	1 160
120	300	520	340	980	1 200
125	320	530	350	1 020	1 230
130	330	540	360	1 050	1 260
135	340	560	370	1 080	1 300
140	360	570	380	1 120	1 330
145	370	590	390	1 150	1 370
150	390	600	400	1 190	1 400
155	400	620	410	1 220	1 430
160	420	630	420	1 250	1 470
165	430	650	430	1 290	1 500
170	450	660	440	1 320	1 540
175	460	680	450	1 360	1 570
180	480	690	460	1 400	1 610
185	490	710	470	1 430	1 650
190	510	720	480	1 470	1 680
195	520	740	490	1 500	1 720
200	540	750	500	1 540	1 750
205	550	770	510	1 580	1 790
210	570	780	520	1 610	1 830
215	580	800	530	1 650	1 860
220	600	810	540	1 690	1 900
225	610	830	550	1 720	1 940
230	630	840	560	1 760	1 980
235	650	860	570	1 800	2 010
240	660	880	580	1 840	2 050
245	680	890	590	1 880	2 090
250	690	910	600	1 910	2 130
255	710	920	610	1 950	2 170
260	720	940	620	1 990	2 210
265	740	950	630	2 030	2 240
270	760	970	640	2 070	2 280
275	770	990	650	2 110	2 320
280	790	1 000			

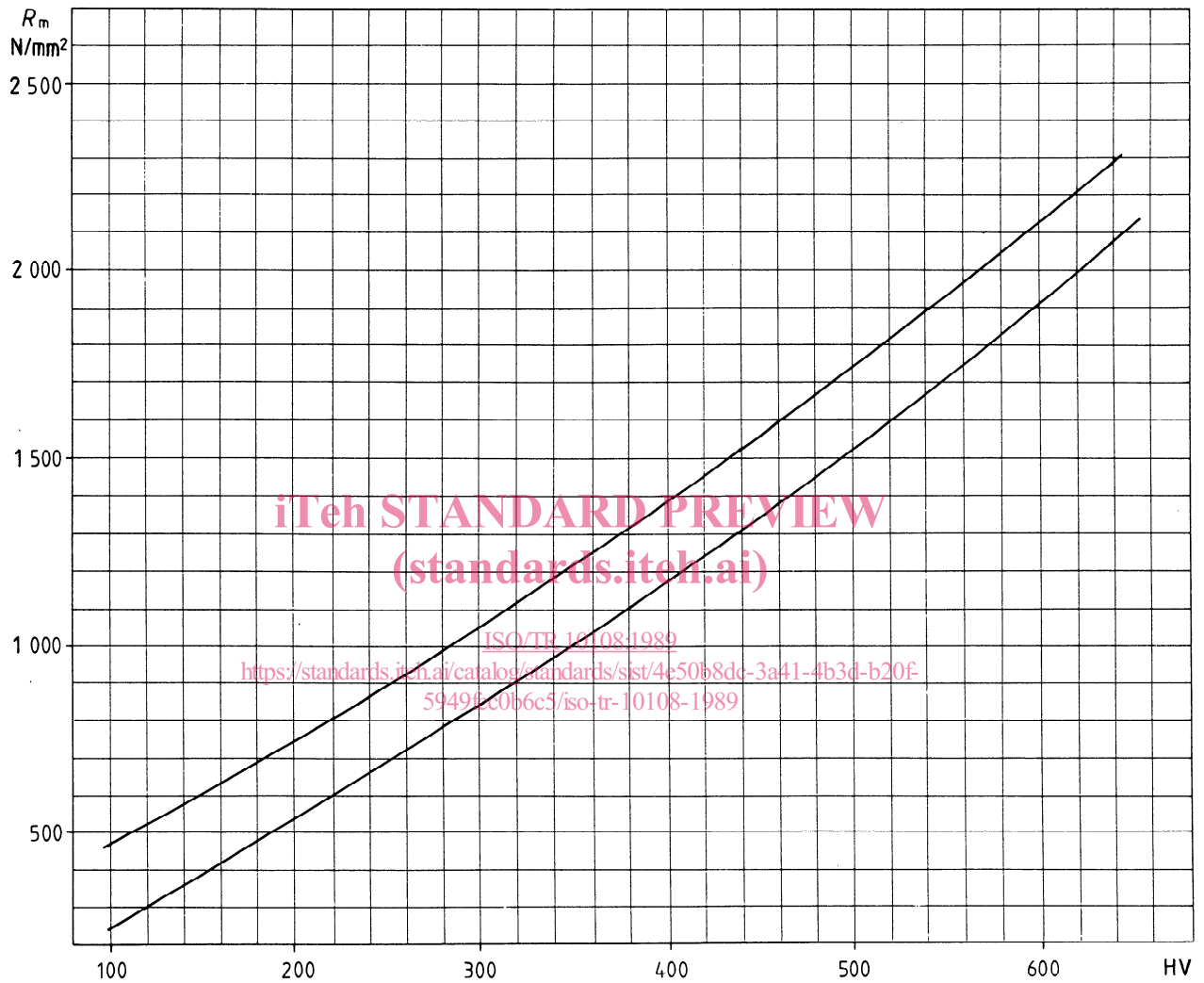
1) 1 N/mm² = 1 MPa

NOTE — The tensile strength values obtained by conversion can under no circumstances replace the values specified in product standards and their use does not obviate the need to carry out the tensile test.



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Figure 1 — Brinell hardness—tensile strength



NOTE — The tensile strength values obtained by conversion can under no circumstances replace the values specified in product standards and their use does not obviate the need to carry out the tensile test.

Figure 2 — Vickers hardness—tensile strength