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Letter to the Editor

Dear Sir:

We would like to share with your readers the current status of the ISO Hardness Testing Standards for Metals. These documents are under the jurisdiction of ISO/TC 164 (Mechanical Testing of Metals), SC 3 (on Hardness Testing).

This short summary reflects the decisions of the most recent meeting of the ISO/TC 164/SC 3 Hardness Testing activity, which was held March 28, 29, 1995, at NIST, Gaithersburg, Maryland, U.S.A.

For more information, please contact the Chairman of the USA TAG activity for TC 164/SC 3:

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Situation of Standardization in the Field of Hardness Testing of Metals

Hardness testing methods are the oldest and most widely known test methods for metallic materials. It is useful to compare the results of hardness testing but it is seen by an accurate comparison that the existing national, regional and worldwide standards contain partly different specifications.

It is generally accepted to strive for a complete alignment of the Hardness Standards in all Standardization levels.

This means reducing the number of meetings and also increasing the precision of the methods as a result of identical testing conditions.

With this goal in mind the department of Materials Testing of DIN took over the secretariat of the responsible ISO committee ISO/TC 164/SC 3 "Hardness testing of metallic materials" in 1994, aiming to achieve the identity of the worldwide ISO-standards with European and other national standards.

This article provides an overview of the situation in standardization work for three typical hardness testing methods: Vickers, Brinell and Rockwell.

General Remarks on the Work of ISO/TC 164/SC 3

In 1994, at the first meeting hosted by the new DIN secretariat, the following important resolutions for general working procedures were approved:

- SC 3 decided that in the frame of the ISO 5-year revision all documents related to a specific hardness test are to be considered at the same time, i.e., the testing method, the verification of the hardness testing machines and the calibration of the reference blocks. This format would ensure the same revision date for all documents related to a specific hardness test (see Table 1).
- SC 3 decided that for future revisions one ISO Standard number is assigned to a specific hardness test with the part numbers 1, 2, and 3 assigned to the above mentioned three parts (see Table 1).
- SC 3 decided on the applicability of the Vienna Agreement between ISO and CEN for any future revision of the Hardness Standards.

Vickers Hardness Test

This is the first standard which will be revised according to the above mentioned resolutions. This means the future ISO number will be ISO 6507 and the new Part 1 involves the previous Parts 1, 2, and 3. Another example is the new ISO 6507-2, which covers the previous ISO 146 and ISO 146-2.

If parallel voting in ISO and CEN is positive, this means for Europe the standard number EN ISO 6507 or for a European country like Germany DIN EN ISO 6507.

In the following the technical amendments are described:

Vickers Testing Method (ISO/DIS 6507-1)

- Combination of the three different standards for the ranges of the test force (ISO 6507-1:1982, ISO 6507-2:1983, ISO 6507-3:1989) into a new Draft Standard ISO/DIS 6507-1 (see Table 2).
- Integration of the tables for calculation of Vickers hardness values for use in tests made on flat surfaces (ISO 490 1:1982, ISO 409:1983, and ISO/DIS 409-3:1992) as Annex C of the new Draft Standard ISO/DIS 6507-1.
- The testing method is specified for lengths of indentation diagonals between 0.020 mm and 1.400 mm.
- If the difference between the lengths of the two indentation diagonals is greater than 5%, this shall be stated in the test report.
- Addition of a new clause 8 concerning the accuracy of the test results.
- Addition of a new informative Annex for monitoring the uncertainty of the testing machine by the users.

TABLE 1—*Overall view of the ISO-Standards for Hardness Testing of metallic materials.*

Standard No.	Title	First edit.	5-year-revision dates 93	94	95	96	97	98	99	00	Revised dates according to resolution No. 153 Standard No.	94	95	96	97	98	99	00
	Brinell	1981				x					6506-1			x				
6506	Test method																	
156	Verification of testing mach.	1982					x				6506-2			x				
726	Calibration of reference blocks	1982					x				6506-3			x				
410	Tabl.	1982					x				incl. in 6506-1							
	Vickers																	
6507-1	Test method HV 5 to 100	1982					x											
6507-2	Test meth. HV 0.2 to < 5	1983	x								6507-1	x					x	
6507-3	Test meth. HV 0.2	1989		x														
146	Verification htm HV 0.2 to 100	1989		x							6507-2							
146-2	Verification htm < HV 0.2	1993						x				x					x	
640	Calibration HV 0.2 to 100	1984		x							6507-3							
640-2	Calibration < HV 0.2	1993										x					x	
409-1	Tabl. HV 5 to 100	1992					x				included in							
409-2	Tabl. HV 0.2 to < 0.5	1983	x								6507-1							
409-3	Tabl. HV < 0.2																	
	Rockwell																	
6508	Test method scales A–K	1986				x					6508-1		x					x
1024	Test method scales N/T	1989			x													
716	Verification htm scales A–K	1986				x					6508-2							
1079	Verification htm scales N/T	1989		x									x					x
674	Calibration scales A–K	1988	x								6508-3							
1355	Calibration scales N/T	1989		x	x								x					x
	Macro Rockwell																	
CD 11700-1	Test method																	
CD 11700-2	Verification htm																	
CD 11700-3	Calibration blocks																	
	Knoop																	
4545	Test method	1993						x			4545-1					x		
4546	Verification htm	1993						x			4545-2					x		
4547	Calibration blocks	1993						x			4545-3					x		
10250	Tabl. K hardn. val.							x			incl. in 4545-1							
	Universal hardness																	
TR 14577	Technical Report	1995																

TABLE 2

Ranges of test force, F N	Hardness symbol	Previous designation
$F \geq 49.03$	≥ HV 5	Vickers hardness test
$1{,}961 \leq F < 49.03$	HV 0.2 to HV 5	Vickers low force hardness test
$0{,}098\ 07 \leq F < 1.961$	HV 0.01 to HV 0.2	Vickers microhardness test

TABLE 3

Diagonal length d mm	Estimation capability of the measuring device	Maximum permissible error
$d \leq 0.040$	0.0002 mm	0.0004 mm
$d > 0.040$	0.5 % d	1.0 % of d

Verification of the Testing Machines (ISO/DIS 6507-2)

- Combination of the two different parts for the verification of the hardness testing machines (ISO 146:1989 and ISO 146-2:1993) into the new Draft Standard ISO/DIS 6507-2.
- Addition of a new table for the estimation capability and the maximum permissible error of the measuring device (see Table 3).
- Changing of the values for the repeatibility of the testing machine on the basis of a statistical calculation of D. Dengel [*1*] and an analysis of testing machines over the last five years, carried out by MPA (Materials Testing Institute) Dortmund and Hannover (see Table 4).
- Addition of a new clause 6 concerning the intervals between the verifications.
- Addition of a new Annex A "Notes on diamond indenters."
- Addition of a new Annex B "Example of a method for an indirect verification of the measuring system."

Calibration of Reference Blocks (ISO/DIS 6507-3)

- Combination of the two different parts for the calibration of the hardness reference blocks (ISO 640:1984 and ISO 640-2:1993) into a new Draft Standard ISO/DIS 6507-3.

TABLE 4

	Repeatability of the testing machine max.						
	$\bar{d}$			HV			
				HV 5 to HV 100		HV 0.2 to < HV 5	
Hardness of the reference block	HV 5 to HV 100	HV 0.2 to < HV 5	< HV 0.2	Hardness of the reference block	HV	Hardness of the reference block	HV
≤ 225 HV	0.03 $\bar{d}$	0.06 $\bar{d}$	0.06 $\bar{d}$	100	6	100	12
				200	12	200	24
				250	10	250	20
≥ 225 HV	0.02 $\bar{d}$	0.04 $\bar{d}$	0.05 $\bar{d}$	350	14	350	28
				600	24	600	48
				750	30	750	60

where

$$\bar{d} = \frac{d_1 + d_2 + \ldots + d_5}{5}$$

The error of the testing machine under the particular verification conditions is characterized by the difference:

$$\bar{H} - H$$

where

$$\bar{H} = \frac{H_1 + H_2 + \ldots + H_5}{5}$$

in which
$H_1, H_2, \ldots, H_5$ are the hardness values corresponding to $d_1, d_2, \ldots, d_5$; H is the specified hardness of the reference block used.

- Addition of a new Figure 1 for the demonstration of the permissible difference of the sectional planes of the square form of the indenter.
- Addition of a new table for the estimation capability and the maximum permissible error of the measuring device.

Rockwell and Brinell Test

The revision of the Rockwell and Brinell Standards will be carried out in 1995/96, using the procedure described in the above mentioned resolutions. Basis documents will be the European standards EN 10003 (Brinell) and EN 10109 (Rockwell) (published in 1994). Details about these European standards are given in [2].

Universal Hardness Test

This Work Item was approved in 1993 and it was decided to start this work as a Technical Report, because it was felt necessary to get more experience in this field of prenormative work. This Technical Report will be published in 1995 as ISO TR 14577. According to the ISO rules for Standardization work the responsible Technical Committee must decide three years after the publication of the TR on the transformation of this TR to a standard or if this TR should be withdrawn.

The secretariat of ISO/TC 164/SC 3 asks all interested persons to take part in this field of prenormative work.

Summary

In the past there have been a number of differences between the international and national standards for Hardness Testing.

Taking into account the new rules for standardization in Europe and the increasing interest in the International Standardization work it was possible to reach the described process. Following items are important for a further future process:

- priority participation in the International Standardization
- careful preparation of International meetings by the national member bodies
- avoidance of duplication of work in ISO and CEN by applying the Vienna Agreement.

References

[1] Dengel, D., "Study About the Verification of Vickers Hardness Testing Machines," (Document ISO/TC 164/SC 3 N 596).

[2] Polzin, T. and Wehrstedt, A., "Übersicht über den Stand der Normung auf dem Gebiet der Harteprüfung metallischer Werkstoffe," *HTM 48*, 1993 and also *Materialprüfung*, 35, 1993 10.