15th Meeting of the CCM
26 February 2015, BIPM

Update: Working Group on Hardness

Sam Low

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« Chairmanship Changes »

From 1998 [Ad-hoc WGH] until March 2014:

Chair: Alessandro Germak (IMGC/INRIM)

Secretary: Sam Low (NIST)

From March 2014:

Chair: Sam Low (NIST)

Vice-Chair: Febo Menelao (PTB)

[approved by WGH members October]

« Terms of Reference »

(slightly revised)

1) To advise the CCM on matters relating to hardness;
2) To improve harmonization of primary standards by developing new primary definitions and/or organizing pilot studies;
3) To organize key comparisons for supporting the CIPM MRA;
4) To support activities of RMOs;
5) To produce working documents for the evaluation of uncertainty;
6) To maintain good links and interface with the hardness community
   - *IMEKO TC5* – Hardness Measurement
7) To provide formal liaison among organizations involved in the standardization
   - *ISO TC164/SC 3* - Mechanical testing of metals / Hardness testing
   - *ASTM-International Committee E28.06* - Mechanical Testing / Indentation Hardness Testing

Note: OIML TC10/SC5 hardness documents were withdrawn; SC5 no longer exists

« Program of work of the WGH for the next 5 years »

- Development of international primary definitions for Brinell, Vickers and Rockwell scales
  (activity already started in 2011 – end of activity by 2020)

- KCs & Pilot Studies in different hardness scales:
  [CCM.H-K2] Brinell hardness: Key Comparison - Complete Report (2015)
  [CCM.H-K3] Rockwell C hardness (HRC): Key Comparison - Initiate measurements all 4 regions (2015)
  [CCM.H-P1] Rockwell diamond indenters: Pilot Study - Complete data analysis and Report (2016)
  [CCM.H-P2] Leeb (HL): Pilot Study - Complete measurements (2015)

  [Planned] Rockwell B (HRBW): Key Comparison or Pilot Study - Develop test protocol (2016)
  [Planned] Rockwell N (HR15N, HR30N and HR45N): Key Comparison - Develop test protocol (2016)
  [Planned] Brinell (HBW scales to be determined): Key Comparison - Develop test protocol (2017)

- Future activities to improve the measurement traceability through development of primary definitions and organization of KCs and pilot Studies:
  - instrumented indentation test
  - nano-indentations
  - dynamic hardness
  - portable hardness testers,
  - hardness of elastomers,
  - Martens hardness

« Present Membership (NMIs and individuals) »

	Institute	*Country*	*Delegate*	*Technical Experts*
1	CENAM	Mexico	Alfredo Esparza Ramírez	
2	GUM	Poland	Anna Osinska-Karczmarek	
3	**INMETRO**	**Brazil**	**Renato Reis Machado**	Sergio Pinheiro de Oliveira
4	INRIM	Italy	Alessandro Germak	
5	**KEBS**	**Kenya**	**Josephat Bang'i** [Replaced David Kimetto]	
6	**KRISS**	**Korea, Republic of**	**N. H. Tak** [Previous delegate Gun Woong Bahng retired from KRISS]	**Junhee Hahn**
7	LNE	France	Stéphane Lefrançois	
8	**NIM**	**China**	**He Li**	
9	NIMT	Thailand	Sanponpute Tassanai	Rugkanawan Wongpithayadisai
10	**NIST**	**United States of America**	**Samuel Low**	**John Song**
11	**NMIJ**	**Japan**	**Koichiro Hattori**	Satoshi Takagi
12	NMISA	South Africa	Corné Gouws [Previous delegate Benny Burke retired from NMISA]	
13	**NPL**	**United Kingdom**	**Andy Knott**	**Nigel Jennett**
14	**PTB**	**Germany**	**Febo Menelao**	
15	SMU	Slovakia	Robert Spurný	
16	SP	Sweden	Leslie R. Pendrill	
17	UME	Turkey	Cihan Kuzu	
18	VNIIFTRI	Russian Federation	Edward Aslanyan	Andrey Aslanyan
19	VNIIM	Russian Federation	Natalia G. Domostroyeva	
20	VSL	Netherlands	Gerard Kotte	

Yellow highlight indicates change to personnel since last CCM meeting.
***Bold** indicates the attendees to the last meeting*

No proposal for new membership

« WGH Meeting held since last CCM»

15th meeting of the WGH

Friday, 17th October 2014

Suzhou International Conference Center
Suzhou, Jiangsu, China

(in coincidence with the meetings of *ISO TC 164 Mechanical testing of metals* held that week in the same location)

8 NMIs represented

11 delegates and technical experts

5 visitors

No WGH meeting was held in 2013

« Next Planned WGH Meeting »

The next meeting will likely be held in conjunction with the meetings of:

ISO TC 164 Mechanical Testing of Metals
National Physical Laboratory (NPL), Teddington, UK
Week of 6 to 11 September 2015 (tentatively 9 September).

ISO Host organization:
British Standards Institute

« Liaisons with RMO KCs »

RMO and Name	Scale	Year	Hardness levels	Status
APMP.M.H- K1.b	Vickers 1	2003/2004	200 HV, 600 HV and 900 HV	In progress
APMP.M.H- K1.c	Vickers 30	2003/2004	200 HV, 600 HV and 900 HV	In progress
APMP.M.H- S1	Rockwell C	2004/2005	20 HRC to 60 HRC	Approved and published
APMP.M.H- S2	Rockwell A and B	2009	35 HRA to 85 HRA, and 25 HRB to 100 HRB	Approved and published
APMP.M.H- S3	Rockwell A and B	2009/2010	35 HRA to 85 HRA, and 25 HRB to 100 HRB	Approved and published
APMP.M.H- S4	Rockwell C	2011	30 HRC, 45 HRC and 60 HRC	Planned
COOMET.M.H-K1	Vickers HV1, HV5, HV30	2007/2010	400 HV, 700 HV	Protocol complete
COOMET.M.H-K1.b	Vickers 1	2004	240 HV, 540 HV and 840 HV	Approved and published
COOMET.M.H-K1.c	Vickers 30	2004	240 HV, 540 HV and 840 HV	Approved and published
COOMET.M.H-K2	Brinell Hardness	2007/2010	100 HBW, 200 HBW, 400 HBW	Protocol complete
COOMET.M.H-S1	Rockwell and Super-Rockwell	2007/2008	60 HRA, 70 HRA, 80 HRA, 60 HRB, 75 HRB, 100 HRB, 30 HRC, 50 HRC, 65 HRC, 70 HR15N, 80 HR15N, 90 HR15N, 50 HR30N, 60 HR30N, 75 HR30N, 30 HR45N, 50 HR45N, 65 HR45N, 80 HR15T, 85 HR15T, 90 HR15T, 55 HR30T, 65 HR30T, 80 HR30T	Approved and published
COOMET.M.H-S2	Martens hardness and Indentation Hardness	2014/2016	HM (0.1 GPa, 3 GPa and 12 GPa), HIT (0.2 GPa, 9 GPa and 23 GPa)	In progress

« KCs underway »

- CCM.H- K2 Brinell Hardness scale (2003 – 2004)

  Key comparison in Mass, Hardness

  Status Report in progress, Draft A

  Problems: The Pilot Lab leader was temporarily detailed to another job. Now that he has returned, the report should be completed within the year.

- CCM.H- K3 Hardness Rockwell C (HRC) scale (2011 – 2012)

  Key comparison in Mass, Hardness

  Status: Underway

  Problems: A number of instrument issues delayed the start. Participation needs to be re-confirmed.

« Pilot Studies underway »

- CCM.H-P1 Rockwell diamond indenters (2010)
  Pilot Study in Mass, Hardness
  Status: Measurements completed (2013), uncertainty calculation for the pilot study underway.
  Problems: Two NMIs have not yet submitted their results.

- CCM.H-P2 Leeb hardness (2014)
  Pilot Study in Mass, Hardness
  Status: Underway

Planned Test Schedule:

Laboratory (Country)	Time frame for measurements
Physikalisch Technische Bundesanstalt - PTB (Germany)	November 2014
Proceq (Switzerland)	December 2014
National Institute of Metrology - NIM (China)	January 2015
Korea Research Institute of Standards and Science – KRISS (Republic of Korea)	February 2015
Physikalisch Technische Bundesanstalt - PTB (Germany)	March 2015
Compilation of Results	April 2015
Review of Report by Participants	June 2015
Submission of Report to BIPM / CCM	August 2015

« Future Comparisons »

Planned

- Rockwell B (HRBW): Key Comparison ***or*** Pilot Study
- Rockwell N (HR15N, HR30N and HR45N): Key Comparison
- Brinell (HBW scales to be determined): Key Comparison

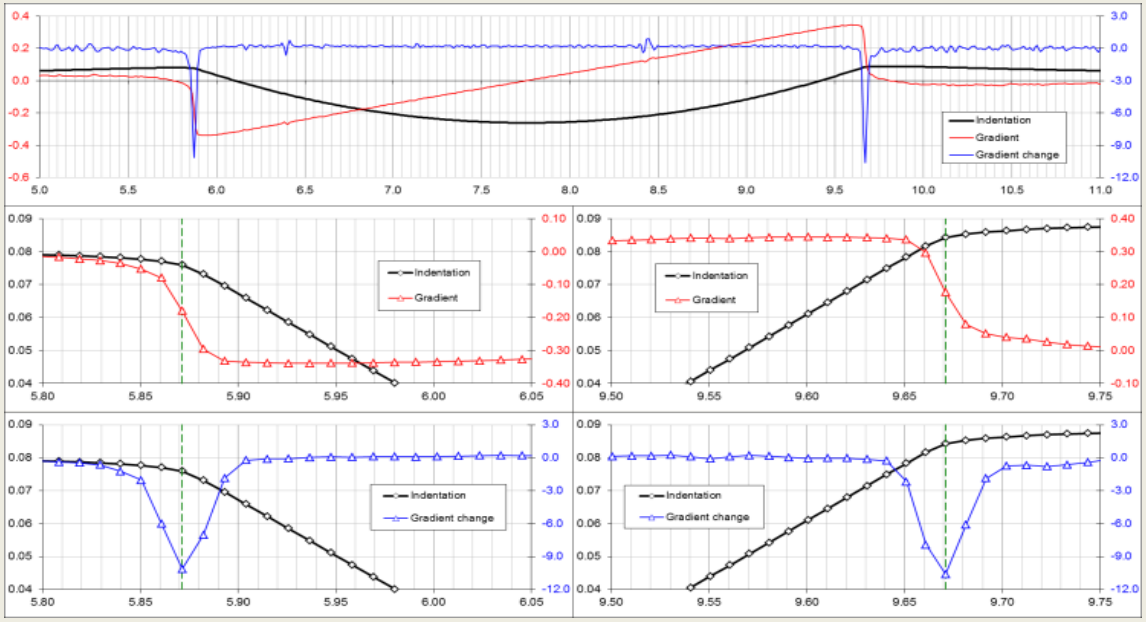
Discussed

- Shore hardness D scale (HSD) : Key Comparison
- Related to Instrumented Indentation Testing (IIT): Key Comparison

The current and planned KCs are sufficient for CMCs in hardness field.

« Major successes (since last CCM) »

- Preliminary discussions through email correspondence were made between NIST, INRIM, PTB, NMIJ and KRISS to develop definitions for the Rockwell scales (HRBW, HRN). Draft definitions were developed. Currently only the HRC scale is defined by the WGH.
- New definitions of the Brinell hardness indentation and Brinell indentation edge have been proposed that are based on direct physical measurement of the indentation rather than optical observation. These definitions will likely be integral to the WGH definition of the Brinell hardness test.



« Major successes (since last CCM) (continued) »

- Preliminary discussions through email correspondence were made between NIST, NIMT and INRIM to develop proposals for the next WGH Key Comparisons. It is likely that a KC for the HR15N, HR30N and HR45N scales can be quickly planned using a similar protocol as for the HRC scale KC. Plans for an HRBW scale KC have been discussed, with several proposals given for handling the instability problems of the test material.
- For the CCM.H-K3 Key Comparison of the Rockwell C Hardness (HR) scale, a preliminary comparison among the four Pilot Labs (NMIJ, NIST, PTB, INRIM) has been carried out. Measurements have been initiated in the Americas regional comparisons (NIST, Pilot Lab).
- The measurements have been completed for the Pilot study on Rockwell diamond indenters (CCM.H-P1).
- A Pilot study on Leeb hardness (CCM.H-P2) has been initiated.

« Major problems (since last CCM) »

- Delay in the Report for the Brinell hardness KC (CCM.H- K2); the Pilot Lab leader was temporarily detailed to another job. Now that he has returned, completion of the report will commence.

- Delay in initiating the Rockwell C scale hardness KC (CCM.H- K3). A number of instrument issues delayed the start. Participation needs to be re-confirmed. However, measurements have been initiated in the Americas regional comparisons (NIST, Pilot Lab)

« Technology trends & challenges in hardness field »

The Working Group on Hardness (WGH) deals with Hardness standards and promotes the international cooperation among NMIs, DIs, RMO members and international organization like ISO, ASTM, VAMAS and others, for improving traceability and standardization in the field.

An increase in the demand of traceability is foreseen in the instrumented indentation test, nano-indentations, dynamic hardness, portable hardness testers, hardness of elastomers and Leeb hardness.

Thank you