Report of the CCM Working Group on Hardness

Sam Low – Chair CCM-WGH

17th CCM meeting, 16 May 2019

Bureau International des Poids et Mesures

Proposed changes to membership

- CCM-WGH Membership is by Institute (20) with one delegate and the option of one additional Technical Expert

Since 2017

- No changes in Institutes have occurred or are proposed
- Two delegates have changed

NMISA	South Africa	Sipho Dlamini replaced Corné Gouws
VNIIFTRI	Russian Federation	Andrey Aslanyan replaced Edward Aslanyan

WG Meetings held since last CCM

- 18th meeting — 19 September 2018 — Stockholm, Sweden
  at the Swedish Standards Institute (SIS) conference centre
  (in coincidence with the meetings of ISO TC 164 Mechanical testing of metals held that week in the same location)
  - 8 Institutes in attendance (9 Delegates and Technical Experts)
  - Decisions on finalizing Reports of 3 Pilot Studies
  - Hardness Definitions for Rockwell 15N, 30N and 45N scales
  - Proposal for maintaining stocks of well characterized indenter balls for Rockwell and Brinell
  - New plan for Rockwell C Key Comparison
  - Next KCs & Pilot Studies: Rockwell 15N, 30N and 45N scales, Brinell, Rockwell B scale
  - Future KCs: Vickers, Instrumented Indentation Testing (IIT)
  - Discussion of to what extent IIT measurements should be under the CCM-WGH. No conclusive decision.

WG Meetings planned

- The 19th meeting of the CCM-WGH will be held in Ulm, Germany at Zwick GmbH & Co. KG on Friday 27 September 2019 (9 am to 5 pm).
  - Analyses of CMCS by NMIs and possible sub-Group
  - Discussion of How Far The Light Shines
  - Creation of Guidance Documents
  - Firm plans of new KCs

- The 20th meeting of the CCM-WGH will be held in Conshohocken, Pennsylvania, United States at ASTM International Headquarters in 2020, date to be determined.

- The CCM-WGH meetings are scheduled to coincide with the Meetings of ISO TC 164 on Mechanical Testing of Metals, which includes ISO TC164/SC3 on Hardness testing, occurring the same week.

Main actions taken and main achievements

- Three Pilot Studies are completed, the Final Reports reviewed and accepted by participants and will soon be approved and submitted for publishing on the BIPM website:
  - CCM.H-P1 Pilot study on Rockwell diamond indenters
  - CCM.H-P2 Pilot study of Leeb hardness reference blocks scale D and G
  - CCM.H-P3 Pilot Study of Brinell Hardness scale

Main actions taken and main achievements

- Development of definitions for hardness scales.
  [Currently only the Rockwell HRC scale is officially defined by the WGH.]
  - **Rockwell HR15N, HR30N and HR45N scale**s – developed, soon to be circulated to the CCM-WGH for approval.
  - **Rockwell HRBW scale** – developed, however, there is yet to be a decision for how to define the indenter ball. [WGH stocks of balls?] [INRiM has agreed to investigate the WC ball influences.]
  - **Leeb hardness scales** – PTB continues to develop draft definitions for the **Leeb** hardness scales.
  - **Knoop and Vickers hardness** – NPL continues to investigate the development of draft definitions for the Knoop and Vickers hardness.

Main actions taken and main achievements

- In order to advance and shorten the process for a Rockwell C hardness (HRC) scale KC comparison, the CCM-WGH decided to…

  - Revise the technical protocol plan for the HRC scale KC (CCM.H-K3) from having all NMIs participate in the KC to only having 5 NMIs participate to determine the reference values.
  - The participants will be INRiM-Italy (Pilot lab), PTB-Germany, VNIIFTRI–Russian Federation, KRISS–Republic of Korea and NMIJ–Japan.
  - The other NMIs will obtain their equivalence through Regional Metrology Organization (RMO) Key Comparisons, which will include one or more of the participating NMIs of the KC. A new revised Technical Protocol has been prepared.

Progressing the state of the art

- Defining hardness tests for an optimum balance between lowest measurement uncertainty and industrial needs [complicated due to the measurement being method dependent]. Example: Rockwell hardness test cycle timing.
- Improving hardness test methods through influence parameter investigations and transferring the knowledge to standards development organizations. Example: optical requirements for indentation measuring systems.
- Possible improved stability in Rockwell ball scale reference block transfer standards. Example: Rockwell hardness reference blocks.

Liaison & stakeholders

- 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.

- Stakeholders:
  - Producers of hardness equipment and reference standards
  - Industries and customers that rely on hardness measurement data for assuring the desired and required properties of their products

KCs completed and underway

- Completed:

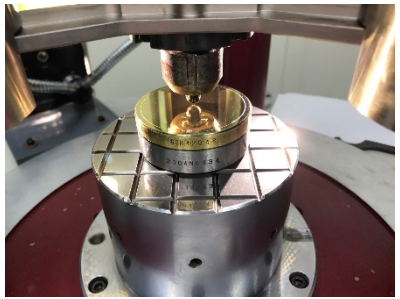
  CCM.H-K1 Vickers hardness(HV 0.2, HV 1, HV 10) scales

- Underway:

  CCM.H-K3 Rockwell C hardness (HRC) scale

KCs planed

- It is proposed that VNIIFTRI – Russian Federation pilot Key Comparisons of the HR15N, HR30N and HR45N scales.
- It is proposed that PTB -Germany pilot Key Comparisons of Brinell hardness.
  - Four scales are proposed:
    HBW 1/30, HBW 2.5/187.5, HBW5/750 and HBW10/3000.
  - Measurements at 2 or 3 hardness levels:
    250 HBW, 350 HBW and 450 HBW for each scale.
- A Pilot Study or KC for the Rockwell HRBW scale is being delayed until additional research in a block design is investigated at NIST.



Program of work for the next 5 years

- Develop additional hardness measurement definitions
- Complete the Rockwell C Key Comparison (CCM.H.K3)
- Initiate new Key Comparisons

CCM.H-K4	Brinell hardness (HBW)	2019	HBW hardness levels 250, 350, 450 HBW scales HBW1/30, HBW2.5/187.5, HBW5/750, HBW10/3000
CCM.H-P4	Rockwell B scale (HRBW)	2020	20 HRBW, 40 HRBW, 60 HRBW, 80 HRBW, 95 HRBW
CCM.H-K5	Rockwell HR15N scale (HR15N)	2021	72 HR15N, 78 HR15N, 83 HR15N, 90 HR15N, 94 HR15N
CCM.H-K6	Rockwell HR30N scale (HR30N)	2022	46 HR30N, 55 HR30N, 64 HR30N, 78 HR30N, 86 HR30N
CCM.H-K7	Rockwell HR45N scale (HR45N)	2023	22 HR45N, 37 HR45N, 49 HR45N, 67 HR45N, 78 HR45N

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