CCM WG Pressure and Vacuum: Report to CCM 2015

CCM WG PV

Karl Jousten, PTB

Content of presentation

1. **Merging HP and LP**
2. **Membership**
3. **Comparisons**
4. **Recent other activities**

May 2011

CCM WG Pressure and Vacuum – Merging HP and LP

Until 1992: 4 WGs for pressure scale
High pressures
Medium pressures
Low pressures
Very low pressures (only a few years, given up 1992)

Until 2005: 3 WGs for pressure scale
High pressures
Medium pressures (given up 2005)
Low and very low pressures

2005-2014: 2 WGs for pressure scale
High pressures
Low pressures

CCM WG Pressure and Vacuum – Merging HP and LP

Shortly before HP and LP meeting 2/2014 proposal by CCM chair to merge the two WGs. Concerns at the common HP/LP meeting:

1) HP (force/area) and LP (gas density/ideal gas law) are basically not the same unit.
2) Apply completely different methods to realize the scale
3) Very different groups of industrial clients for pressure or vacuum
4) One WG: NMI will send one expert (either HP or LP) - WG meetings are downgraded to management meetings instead of expert meetings that drive the field
5) Similar: Chair is only expert for pressure *or* vacuum
6) Work load too big for one chair
7) Merging has no synergetic effect for the work

No member in favour of merging, several had no preference.

CCM WG Pressure and Vacuum – Merging HP and LP

After some discussion with CCM chair (July 2014):

Two groups HP and LP are merged with the following conditions:

1. Name of the merged group: CCM Working Group for Pressure and Vacuum (CCM WG PV)
2. The WG PV will consist of two subgroups, one for pressure (P) and one for vacuum (V). If an NMI names two experts (P+V), only one will be the official delegate with voting right.
3. The CCM WG PV shall be managed by a chair and a vice chair. The vice chair shall always complement the experience of the chair (pressure or vacuum).
4. Both chair and vice chair may convene a meeting in their field of experience. In normal cases the whole WG PV shall have a meeting convoked by the chair.

CCM WG Pressure and Vacuum – Merging HP and LP

New Terms of References (ToR), dated July 2014:

The CCM Working Group on Pressure and Vacuum (WGPV) is concerned with the metrology of gauge, differential and absolute pressure between 1E-9 Pa and 1E10 Pa (pressure and vacuum) as well as very low gas flow ("leaks").

The main tasks of the group are:

- to advise the CCM on issues related to pressure and vacuum metrology,
- to define and organise the CIPM Key Comparisons for establishing the equivalence of national primary standards for pressure and vacuum and very low gas flow at the highest accuracy level mainly to provide sufficient linkage between RMO and the CCM WGPV,
- to encourage and, if requested, coordinate research and development in the field of pressure and vacuum metrology to cope with the present and future needs of science, industry and society worldwide,
- to harmonize guidelines in the field of pressure and vacuum metrology related to the CIPM-MRA.

CCM WG Pressure and Vacuum – Merging HP and LP

Terms of reference/discussion with CCM chair (July 2014):

WG proposal for ToR as last sentence:
In order to maximize the experience in leadership both for the pressure and vacuum, always a vice chair with competence in the complementary field of the chair (either pressure or vacuum) shall act.

Philippe Richard:
Thanks for the revised ToR. It is fine for me with one exception. I still do not want management issues in the ToR. I suggest that the last sentence of the ToR **officially appear in the minutes of the next CCM meeting**.

CCM WG Pressure and Vacuum – Merging HP and LP

In addition the WG PV wants to include the following in the minutes of this CCM meeting (agreement achieved with CCM chair, but only in form of email exchange):

1) In order to maximize the experience in leadership both for the pressure and vacuum, always a vice chair with competence in the complementary field of the chair (either pressure or vacuum) shall act.

2) The WG PV will consist of two subgroups, one for pressure (P) and one for vacuum (V). If an NMI names two experts (P+V), only one will be the official delegate with voting right.

3) Both chair and vice chair may convene a meeting in their field of experience. In normal cases the whole WG PV shall have a meeting convoked by the chair.

CCM WG Pressure and Vacuum – Membership

Membership WG PV (20 NMI)

AStar (Singapore), CENAM (Mexiko), CEM (Spain), CMI (Czech Republic), INMS-NRC (Canada), INRIM (Italy), KRISS (Korea), LNE (France), METAS (Switzerland), MSL-NZ (New Zealand), NIM (China), NIST (USA), NMIA (Australia), NMIJ (Japan), NMISA (South Africa), NPL-I (India), PTB (Germany), SMU (Slowakia), UME (Turkey), VNIIM (Russia)

Personal member: Dr. Janez Setina (MIRS, Slovenia)

Observer: INMETRO (Brasil), IPQ (Portugal)*, NIS (Egypt)

In total 35 individuals.

Meetings: Typically every 3 years. Proposed next meeting in May 2017. CCM international conference on pressure and vacuum metrology every 6 years. Next time May 2017, organised by METAS.

* Contact lost to representative Isabel Spohr

CCM WG Pressure and Vacuum – Membership

SMU (Slovakia)

At 2/2014 meeting of WG LP proposal to exclude SMU from WG, since Peter Farar retired and SMU was no more active since several years, neither participated in KCs.

May 2015: SMU is provisionally restored. However, at the next meeting of WG PV, the representative of SMU will be invited to make a short presentation on current capabilities and relevant technical work, after which the membership of the WG will decide whether SMU may be listed as a member.

NIS (Egypt):

Shortly, before merging WG HP and LP, application of NIS to become a member of WG HP. NIS is not a member of CCM, and AFRIMETS representation is ensured by NMISA after the merging of WG HP and LP. Chair decides to invite NIS as guest and delays decision for the next WG PV meeting.

CCM WG Pressure and Vacuum – Key comparisons

CCM.P-K12 (leak rates, published 2013), organised by WG LP(PV), but

after agreement in 2013 with WG FF, CMCs in “their” field by 2 countries:

Mass and related quantities, Fluid flow, Fluid flow, Gas flow rate, Molar flow rate

CCM.P-K12.1 (Leak/flow rates at 3×10^{-11} mol/s):

Participants: IMT/CMI bilateral

Pilot Lab: IMT

Motivation: CMI showed inconsistent data with reference value in K12

Draft B completed.

CCM WG Pressure and Vacuum – Key comparisons

CCM.P-K14 (10^{-4} Pa to 1 Pa):

Participants: 7 NMIs (APMP, EURAMET, SIM)

Pilot Lab: METAS

Measurements: 2010-2011 (within 12 months!)

Draft B completed (February 2015).

CCM WG Pressure and Vacuum – Key comparisons

CCM.P-K3.1 ($3 \cdot 10^{-6}$ Pa to $9 \cdot 10^{-3}$ Pa):

Pilot Lab: NIST

Participants: bilateral NIST/PTB due to non-equivalence of PTB in K3.

Measurements: 2011-2012

Published.

Equivalence of PTB proved after repair of standard.

CCM WG Pressure and Vacuum – Key comparisons

CCM.P-K4.2012 (1 Pa to 10 kPa):

Participants: 7 NMIs (AFRIMETS, APMP, COOMET, EURAMET, SIM)

Pilot Lab: NIST

Measurements: 2012-2013 (NMISA had to withdraw, did not deliver data)

Draft A (completed June 2014).

CCM WG Pressure and Vacuum – Key comparisons

CCM.P-K3.201X ($3 \cdot 10^{-9}$ Pa to $3 \cdot 10^{-4}$ Pa):

Decided 2011.

Pilot Lab: NMIJ

Pilot study (NMIJ, PTB) completed 2014, submitted for publication.

Planned start of measurements: 2016 (please, approve)

Environmental and safety regulations

Customer request calibration of sniffer test leaks (test leaks with flow into atmosphere)

NMIs established calibration standards for this:

CMI, INRIM, LNE, PTB

Others are planning.

Meeting 2014: **New KC after 2017.**

CCM WG Pressure and Vacuum – Key comparisons

At present no KC in pressure field > 100 kPa.

-> Discussion initiated by new WG PV chair.

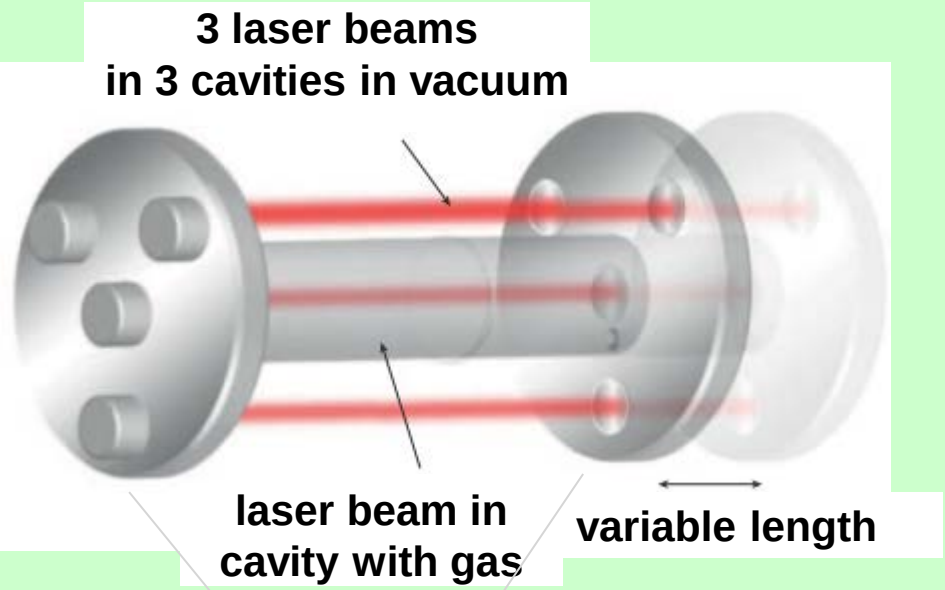
Probably followers of CCM.P-K1a,b,c (gauge pressure, 50 kPa to 7 MPa, completed 1997-1999) will be decided.

Not sufficient material for approval yet.

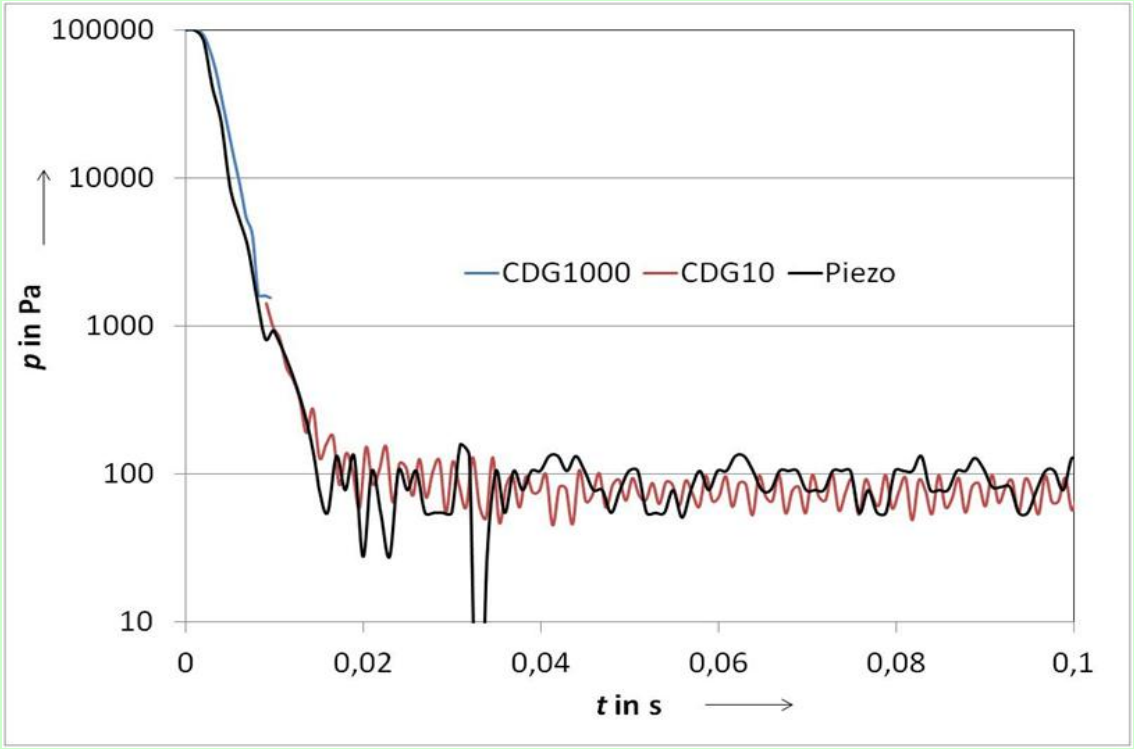
Research for establishing pressure scale (> 1 Pa, < 400 kPa) by refractive index measurement of helium by NIST; **variable-length optical cavity**

$$\rho = \frac{2}{3A}(n-1)$$

ρ gas density, n refractive index, A polarizibility

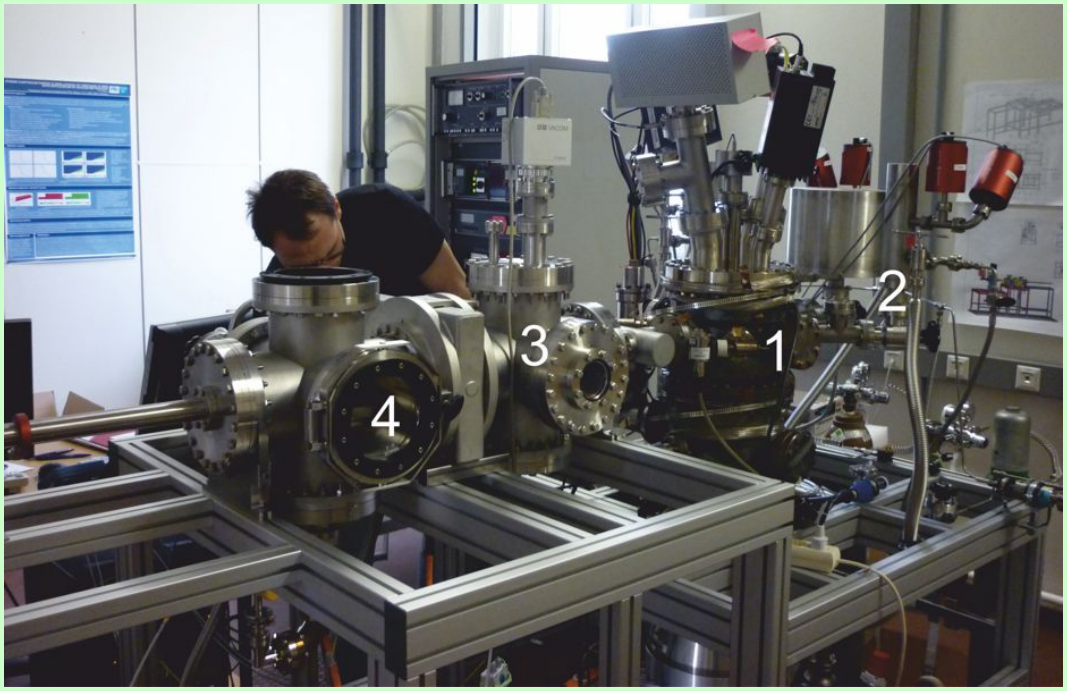


Dynamic vacuum pressure measurement (PTB, EMRP IND 12):
Within 18 ms from 100 kPa to 100 Pa.



CCM WG Pressure and Vacuum – New activities

Establishing traceability for partial pressure measurement and outgassing rate measurement. Close collaboration with ISO TC 112.



1 calibration chamber
2 gas reservoirs to produce gas flows
3 sample chamber for outgassing probe
4 load lock

Implications for mass comparisons in vacuum?

End of report

CCM WG Pressure and Vacuum – Membership

WG PV	Date: 2015-02-12					
Chair	Karl Jousten	Vice chair	Jorge Torres Guzman			
	20 Institutes, 1 personal member and 2 guest institutes (guests are invited for a single meeting)					
	Institute	***Country***	***Individual(delegate)***	***Field***	***Individual(expert)***	***Field***
member institutes	A*Star	Singapore	Wu Jian	V		
	CEM	Spain	Nieves Medina	PV	Salustiano Ruiz	V
	CENAM	Mexico	Jorge Torres Guzman	PV		
	CMI	Czech Rep.	Dominik Pražák	V		
	INMS-NRC	Canada	Anil Agarwal	PV		
	INRIM	Italy	Mercede Bergoglio	PV		
	KRISS	Korea, Rep. of	Seung-Soo Hong	V	Sam-Yong Woo	P
	LNE	France	Pierre Otal	P	Frederic Boineau	V
	METAS	Swiss	Christian Wüthrich	PV		
	MSL-NZ	New Zealand	Chris Sutton	PV		
	NIM	China	Yang Yuanchao	PV		
	NIST	USA	Jay Hendricks	P	James A. Fedchak	V
	NMIA	Australia	John Man	V		
	NMIJ	Japan	Tokihiko Kobata	P	Hashime Yoshida	V
	NMISA	South Africa	Brian Yalisi	PV		
	NPL-I	India	Ashok Kumar	V		
	PTB	Germany	Karl Jousten	V	Wladimir Sabuga	P
	SMU	Slovakia	Miroslav Chytil	PV		
	TÜBITAK-UME	Turkey	Rifat Kangi	V	Yasin Durgut	P
	VNIIM	Russia	Irina Sadkovskaya	PV	Alexander A. Chernyshenko	V
personal member	MIRS	Slovenia	Janez Setina	V		
guest institutes	INMETRO	Brasil	Jackson Silva Oliveira	PV		
	NIS	Egypt	Alaaeldin A. Eltawil	P		
guest members	NIST	USA	Douglas Olson	P		
	NMIJ	Japan	Hitoshi Akimichi	V		
			Hiroaki Kajikawa	P		
guest individual	INTI	Argentina	Juan Forastieri	P		
To be informed	VNIIM	Russia	Alexey Diatlev			