

**THE INTERNATIONAL ASSOCIATION
FOR THE PROPERTIES OF
WATER AND STEAM**

MEMBERS

Australia
Britain and Ireland
Canada
Czech Republic
Germany and Switzerland
Italy
Japan
New Zealand
NORDIC (Denmark, Finland, Norway, Sweden)
United States of America

ASSOCIATE MEMBERS

Argentina and Brazil
China
Egypt
France
Greece
India
Israel
The Netherlands

EXECUTIVE SECRETARY

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Minutes

of the

General Meeting

of the

International Association for the Properties of Water and Steam

**Boulder, USA
25th June 2024**

Prepared by: Barry Dooley



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**Minutes of the
General Meeting
of the
International Association for the Properties of
Water and Steam
Boulder, USA
25th June 2024**

Tuesday, 25th June 2024. 7:50pm

IAPWS President Friend opened the General Meeting and welcomed the 45 people in attendance. He explained the background to the General Meeting of IAPWS in that it has always been recognized that it is an opportunity for people attending the ICPWS (every five or six years) to observe the workings of IAPWS. IAPWS is an organization of member countries that meets annually in a member country with the primary purpose to advance the properties of water, steam, and aqueous systems and to make this freely available to engineers and scientists the world over. The range of topics is from thermophysical properties to power and industrial plant guidelines. IAPWS gets its work done through Working Groups, covering the topics of interest to the Association, and through Task Groups, typically associated with one or more Working Groups. IAPWS and Working Group meetings are open to anyone.

1. Adoption of Agenda

A preliminary agenda had been circulated to all IAPWS members and had been placed on the IAPWS website by the Executive Secretary in January 2024. Copies of this agenda and the attachments to be discussed at the General Meeting were also available for everybody as a PDF document within the Whova app. There were no suggested changes to the agenda and thus the President requested that it be adopted. It forms Attachment 1 of these minutes. Item 5 of the agenda on proposed activities is meant “for the observers present to make proposals regarding the future directions of the Association”.

2. President's Report on Activities of IAPWS 2018 - 2024

President Friend next provided his report on IAPWS and Executive Committee (EC) activities since the last General Meeting in Prague in 2018:

2.1 Membership. IAPWS now has 9 Member countries and 8 Associate Member countries. Israel and India have become Associate Members since 2018. Russia has been suspended. The Netherlands will apply for Associate Membership during the EC meeting later in the week

2.2 Working Group (WG) Activities. The President introduced the four IAPWS Working Groups and the Sub Committee Committee on Seawater and provided a short description of the activities of these groups which was included within the Whova app of ICPWS activities and is Attachment 2. Everybody was invited to join a WG where the IAPWS work is undertaken.

2.3 Annual Meetings. Attachment 3 delineates the locations of the annual meetings of the IAPWS EC and the past presidents. The next location of an annual meeting is always available on the IAPWS website.

2.4 IAPWS Awards. IAPWS has three awards: Gibbs, Helmholtz and Honorary Fellow. The sixth IAPWS Gibbs Award was presented to Dr. Rainer Feistel at the current ICPWS. The following people had been made IAPWS Honorary Fellows since the last General Meeting: Weber (2018), Rziha (2019), Thomsen and Hruby (2021), Pawlowicz and Leidich (2022), and Okita (2024). The following people had received the Helmholtz Award: Vins (2019), Toyama (2020), Hellman (2021), Patel (2022) and Herrmann (2024). A full listing of all IAPWS awardees is provided in Attachment 4.

2.5 IAPWS Products. The President indicated that developing products was the main goal of the organization and mentioned that IAPWS Releases, Supplementary Releases, Guidelines, Advisory Notes, ICRNs and Technical Guidance Documents were currently in existence. These are provided in Attachments 5 - 10. He also indicated that these products are listed on the IAPWS Web site (www.IAPWS.org).

2.6 Collaborations with Other Organizations. The President mentioned that IAPWS has a number of collaborations with BIPM (International Bureau of Weights and Measures), National metrology labs, IAPSO (International Association for the Physical Sciences of the Oceans), UNESCO, and with the ongoing Symposium on Thermophysical Properties.

2.7 Other. The President informed the gathered General Meeting that IAPWS currently had a succession plan to replace the current Executive Secretary who is stepping down after 35 years. He asked the audience to think about the job and discuss possibilities with himself and/or the Executive Secretary.

3. Executive Secretary's Report on Activities of IAPWS 2018 - 2024

The Executive Secretary provided information that IAPWS was on a sound financial footing. Dues are paid by each Member each year and the funds are used to run the organization and support International Collaborative Projects.

The Executive Secretary also indicated that the IAPWS Financial records had been audited and approved each year by VDI in Germany and Professor Safarik in Czech Republic.

The IAPWS Dues Structure has remained the same.

4. Selection of Host Country for the 19th ICPWS

The location of the next ICPWS will be discussed by the EC at the meeting later in the week.

5. Proposed Activities during Period to Next ICPWS

The President indicated that IAPWS would especially like to hear ideas or suggestions on the future of IAPWS.

6. New Business

The President requested if there were any items of new business. None were raised.

7. Adjournment

The General Meeting adjourned at 8:22pm.

**AGENDA
for the
GENERAL Meeting
of
IAPWS**

Boulder, Colorado, USA.

Tuesday, 25th June 2024. 19:45. Room Math 100.

Opening Remarks by IAPWS President, Dr. Dan Friend

1. Adoption of Agenda
2. President's Report on Activities of IAPWS 2018 - 2024
 - 2.1 Membership
 - 2.2 Working Group Activities
 - 2.3 Annual Meetings
 - 2.4 IAPWS Awards (Gibbs, Helmholtz and Honorary Fellow)
 - 2.5 IAPWS Products (Releases, Guidelines, Advisory Notes, ICRNs and Technical Guidance Documents)
 - 2.6 Collaboration with Other Organizations
 - 2.7 Other
3. Executive Secretary's Report on Activities of IAPWS 2018 - 2024
 - 3.1 Financial, Auditors and Dues
4. Selection of Host Country and Year for the 19th ICPWS
5. Proposed Activities during Period to Next ICPWS
6. New Business
7. Adjournment

Barry Dooley
17th May 2024



**IAPWS WORKING GROUP AND SUB-COMMITTEE MAIN ACTIVITIES
SINCE THE 17TH ICPWS IN PRAGUE, CZECH REPUBLIC (September 2018)**

WORKING GROUP - THERMOPHYSICAL PROPERTIES OF WATER AND STEAM (TPWS)

Chair: Karsten Meier, Vice Chair: Jan Hruby

The Working Group on Thermophysical Properties of Water and Steam has completed new formulations for the viscosity and thermal conductivity of heavy water (D₂O), which are consistent with the 2017 formulation for thermodynamic properties of heavy water, account for the critical enhancement of both transport properties, and are based on zero-density values obtained with the kinetic theory of gases. The new formulations are applicable in wider ranges of conditions than the previous formulations.

Current projects include work to produce a new scientific formulation for the thermodynamic properties of ordinary water, which is intended to replace the IAPWS-95 formulation, work to produce a new formulation for the static dielectric constant of heavy water, work to produce a formulation for the diffusivity of water that covers a wide range of temperature and pressure, production of a new IAPWS formulation for the surface tension of water, and work to produce a guideline providing enhancement factors for solubility of water vapor in important gases at elevated pressures.

WORKING GROUP - INDUSTRIAL REQUIREMENTS AND SOLUTIONS (IRS)

Chair: Francesca di Mare, Vice Chair: Richard Harwood

The mission of the Working Group on Industrial Requirements and Solutions is “To identify and prioritize industrial requirements for water, steam, and aqueous systems, to work with other IAPWS working groups to deliver solutions and to support implementation of solutions”.

The Task Group “Guideline on the Fast Calculation of Steam and Water Properties with the Spline-Based Table Look-Up Method (SBTL)” was set up in 2013, and a new guideline IAPWS G13-15 has been released. Revised Supplementary Releases on Backward Equations, IAPWS-SR2-01, SR3-03, SR4-04 and SR5-05 also have been published for reducing computing times further when using IAPWS-IF97. Advisory Note No. 5 has been newly released for industrial calculations of the thermodynamic properties of seawater. Calculations on wet steam properties have been surveyed for defining industrial requirements to low pressure turbines or wet steam turbines such as nuclear, geothermal and solar thermal turbines.

“New Industrial Requirements” and “Future IRS” were discussed and the Task Group “Categories of Industrial Requirements” has been set up to collect, sort and categorize items of industrial interests or issues for the sake of reconsidering IRS missions and/or roles working with other WGs in IAPWS. IRS is focusing not only on calculation methods of industrial use but also on new issues or interests, for example, effects of wet steam with foreign substances on geothermal plants as one of renewable energies to be developed sustainably. A further aspect which is being assessed within the group is the cooperation and involvement with the aviation industry considering the issues related to hydrogen-propelled aircraft and the emission of potentially large quantities of water vapour in the atmosphere.

SUBCOMMITTEE ON SEAWATER (SCSW)

Chair: Rich Pawlowicz, Vice Chair: <vacant>

In 2013 SCSW joined with the Scientific Committee on Oceanic Research (SCOR) and the International Association for the Physical Sciences of the Oceans (IAPSO) to jointly sponsor a permanent committee to continue developing standards for seawater. This Joint SCOR/IAPSO/IAPWS Committee on the Properties of

Seawater (JCS) was formed with terms of reference developed at a series of workshops held at ICPWS16, with a renewal at ICPWS17. JCS tasks have included maintaining and expanding the TEOS-10 software suite for the properties of seawater, maintaining a TEOS-10 web site (www.teos-10.org), maintaining contacts with the International Bureau of Weights and Measures (BIPM), including participation in meetings of the Consultative Committees on Thermometry (CCT) and Amount of Substance (CCQM), liaising with other groups interested in the properties of seawater and encouraging more research and measurements in this area. JCS includes 4 task groups, concerned with salinity/density of seawater, pH of seawater, the relative humidity of air, and (new for 2023) chemical speciation in seawater.

WORKING GROUP - PHYSICAL CHEMISTRY OF AQUEOUS SYSTEMS (PCAS)

Chair: Ken Yoshida, Vice Chair: Hugues Arcis

The activities of PCAS focus on the fundamental thermodynamic and kinetic properties of aqueous solutions, with particular emphasis on high temperature systems relevant to power generation. Since 2018, the main areas of research have involved developing the formulation of the ionization constant of water (K_w), transport properties, reactivity of inorganic and organic species, fundamental analysis of anti-corrosive film-forming substances in high temperature water, speciation and thermodynamic properties of aqueous solutions in power cycle engineering, properties of simple and complex organic solutes dissolved in water, and cavitation phenomena.

PCAS has been collaborating with TPWS to develop a revised release of the ionization constant of water. A guideline on the self-diffusion in high temperature water is currently being prepared.

WORKING GROUP - POWER CYCLE CHEMISTRY (PCC)

Chair: David Addison (New Zealand), Vice Chairs: Paul McCann (UK); Kirk Buecher (USA), Taro Ichihara (Japan)

The IAPWS Power Cycle Chemistry Group (PCC) is the primary IAPWS Working Group interested in water/steam related chemistry for steam power cycles in conventional fossil, combined cycle, nuclear, solar thermal and geothermal power cycles, along with other industrial process applications of steam including biomass and electrical boilers and other non-conventional and emerging steam generation technologies.

Since 2013, PCC has developed and published further Technical Guidance Documents (TGD) for the control and operation of cycle chemistry in fossil and combined cycle plants, and currently there are 11 existing IAPWS TGD.

The development of additional new TGD is progressing and the following documents are under preparation for finalization in the next two-three years:

- Corrosion product transport for flexible operation plants
- Flue gas condensation
- Geothermal Power Plant steam

Pre TGD development work (white papers) are underway in the following areas

- Electrode boilers

Updates of the following TGD are also underway or planned to incorporate recent advances and learnings

- Instrumentation
- All-volatile Treatment
- Boiler carryover
- Film Forming Substances
- Steam purity.

IAPWS Annual Meetings and ICPWS

<u>Place</u>	<u>Year</u>	<u>ICPWS</u>	<u>President</u>
Giens, France	1974	8th ICPWS	Vodar (France)
Ottawa, Canada	1975		Kestin (USA)
Kyoto, Japan	1976		Kestin (USA)
Moscow, USSR	1977		Bradly (UK)
Washington, USA	1978		Bradly (UK)
Munich, Germany	1979	9th ICPWS	Grigull (Germany)
London, UK	1980		Grigull (Germany)
Prague, Czechoslovakia	1981		Tanashita (Japan)
Ottawa, Canada	1982		Tanashita (Japan)
Tokyo, Japan	1983		Sytchev (USSR)
Moscow, USSR	1984	10th ICPWS	Sytchev (USSR)
Washington, USA	1985		Hill (Canada)
Dusseldorf, Germany	1986		Hill (Canada)
Reading, UK	1987		Grigull (Germany)
Vancouver, Canada	1988		Grigull (Germany)
Prague, Czechoslovakia	1989	11th ICPWS	Pichal (Czechoslovakia)
Buenos Aires, Argentina	1990		Pichal (Czechoslovakia)
Tokyo, Japan	1991		Levelt Sengers (USA)
St. Petersburg, Russia	1992		Levelt Sengers (USA)
Milan, Italy	1993		Cooper (UK)
Orlando, USA	1994	12th ICPWS	Cooper (UK)
Paris, France	1995		Watanabe (Japan)
Fredericia, Denmark	1996		Watanabe (Japan)
Erlangen, Germany	1997		Fernandez-Prini (Argentina)
London, UK	1998		Fernandez-Prini (Argentina)
Toronto, Canada	1999	13th ICPWS	Tremaine (Canada)
Prague, Czech Republic	2000		Tremaine (Canada)
Gaithersburg, USA	2001		Rukes (Germany)
Buenos Aires, Argentina	2002		Rukes (Germany)
Vejle, Denmark	2003		Watanabe (Japan)
Kyoto, Japan	2004	14 th ICPWS	Watanabe (Japan)
Santorini, Greece	2005		Marsik (Czech Republic)
Whitney, UK	2006		Marsik (Czech Republic)
Lucerne, Switzerland	2007		Cooper (BIAPWS)

<u>Place</u>	<u>Year</u>	<u>ICPWS</u>	<u>President</u>
Berlin, Germany	2008	15 th ICPWS	Cooper (BIAPWS)
Doorwerth, The Netherlands	2009		Friend (USA)
Niagara Falls, Canada	2010		Friend (USA)
Plzen, Czech Republic	2011		Daucik (Denmark)
Boulder, USA	2012		Daucik (Denmark)
Greenwich, UK	2013	16 th ICPWS	Petrova (Russia)
Moscow, Russia	2014		Petrova (Russia)
Stockholm, Sweden	2015		Guzonas (Canada)
Dresden, Germany	2016		Kretzschmar (Germany)
Japan	2017		Kretzschmar (Germany)
Czech Republic	2018	17 th ICPWS	Kretzschmar (Germany)
Canada	2019		Hruby (Czech Republic)
Virtual	2020		Hruby (Czech Republic)
Virtual	2021		Nakahara (Japan)
Rotorua, New Zealand	2022		Nakahara (Japan)
Torino, Italy	2023	18 th ICPWS	Friend (USA)
Boulder, USA	2024		Friend (USA)
Helsinki, Finland	2025		Nielsen (NORDIC IAPWS)
	2026		Nielsen (NORDIC IAPWS)

IAPWS AWARDS (June 2024)**IAPWS Gibbs Award**

Year	Gibbs Award
1999	Professor E.U. Franck, University of Karlsruhe (Germany)
2004	Professor R.H. Wood, University of Delaware (USA)
2008	Prof. em. Dr.-Ing. W. Wagner, Ruhr-University Bochum (Germany)
2013	Professor D.D. Macdonald, Berkeley University (USA)
2018	Professor R. Fernández-Prini, CNEA, CONICET and UBA (Argentina)
2024	Dr. R. Feistel, Baltic Sea Research Institute (Germany)

IAPWS Helmholtz Award

Year	Helmholtz Award
2000	Dr. Andrzej Anderko, OLI Systems, Inc., USA
2001	Dr. Nobuyuki Matubayasi, Kyoto University, Japan
2003	Prof. Eric Luijten, University of Illinois, USA
2005	Dr. Valeria Molinero, California Institute of Technology, USA
2006	Dr. Hong-Wei Xiang, Chinese Academy of Sciences, China
2007	Dr. Karsten Meier, Helmut-Schmidt University, Germany
2008	Dr. Noriyuki Yoshii, Himeji Dokkyo University, Japan
2010	Ms. Melonie Myszczyzyn, Canadian Natural Resources Limited, Canada
2011	Prof. Hertanto Adidharma, University of Wyoming, USA
2012	Prof. Maxim Fedorov, University of Strathclyde, Scotland, UK
2013	Prof. Henry Ashbaugh, Tulane University, USA
2014	Prof. Ken Yoshida, University of Tokushima, Japan
2015	Dr. Vincent Holden, Cornell University, USA
2016	Dr. Frédéric Caupin, Université Claude Bernard Lyon 1 et CNRS
2017	Dr. Pavel Gotovtsev, Kurchatov Institute, Russia
2018	Dr. Hugues Arcis, University of Guelph, Canada
2019	Dr. Václav Vinš, Institute of Thermomechanics, Czech Republic
2020	Dr. Ishiyama, Toyama University, Japan (presented at 2021 meeting)
2021	Dr. Robert Hellmann, Helmut Schmidt University of Hamburg, Germany
2022	Prof. Amish Patel, University of Pennsylvania, USA
2024	Dr. Sebastian Herrmann, Zittau/Goerlitz University, Germany

IAPWS Honorary Fellow

Year	Honorary Fellow
1981	Professor S. Beitler Professor H. Hausen Professor J. Juza Professor Sugawara Professor N.B. Vargaftik
1982	Professor B. Vodar
1985	Professor E.J. LeFevre Professor I. Tanishita
1987	Dr. S. Angus Professor U. Grigull Professor J. Kestin Mr. R.C. Spencer
1988	K.R. Schmidt Dr. H.J. White
1990	Dr. G. Bohnsack
1991	Professor O.I. Martynova
1992	Professor A.A. Alexandrov Professor E.U. Franck
1993	Dr. E. Whalley
1994	Dr. J.M.H. Levelt Sengers
1996	Dr. A. Bursik
1997	Professor P.G. Hill Professor J. Straub Professor K. Watanabe
1998	Professor W. Wagner

1999	Mr. J.R. Cooper
2000	Professor B. LeNeindre Professor J.V. Sengers
2001	Professor A. Nagashima Dr. O. Šifner
2002	Dr. R. Fernandez-Prini
2003	Mr. K. Daucik
2004	Mr. K. Miyagawa Professor P. Tremaine
2005	Dr. B. Rukes
2006	Dr. J.C. Bellows Dr. R.B. Dooley
2007	Dr. D.A. Palmer
2008	Dr. R. Svoboda
2010	Dr. G. Bignold
2011	Professor R. Mareš
2012	Dr. D.G. Friend Prof. H.-J. Kretzschmar
2013	Dr. R. Feistel
2014	Professor T. Petrova
2015	Professor M. Nakahara
2016	Dr. A. Harvey
2018	Mr. I. Weber
2019	Mr. M. Rziha
2021	Dr. K. Thomsen Dr. J. Hruby
2022	Professor R. Pawlowicz Dr. F-U. Leidich
2024	Mr. N. Okita

CURRENT IAPWS RELEASES (June 2024)

- **R18-21.** Release on the IAPWS Formulation 2021 for the Thermal Conductivity of Heavy Water. September 2021. This release replaces the thermal conductivity portion of the revised release of 2007 (IAPWS R4-84(2007)).
- **R17-20.** Release on the IAPWS Formulation 2020 for the Viscosity of Heavy Water. September 2020. This release replaces the viscosity portion of the revised release of 2007 (IAPWS R4-84(2007)).
- **R16-17 (2018).** Release on the IAPWS Formulation 2017 for the Thermodynamic Properties of Heavy Water. September 2018. (This replaces the revised release of 2005 which replaced the original release of 1984).
- **R15-11.** Release on the IAPWS Formulation 2011 for the Thermal Conductivity of Ordinary Water Substance. September 2011.
- **R14-08(2011).** Revised Release on the Pressure along the Melting and Sublimation Curves of Ordinary Water Substance. September 2011. (This is a minor revision of the 2008 revised release, which replaced the corresponding release of 1993)
- **R13-08.** Release on the IAPWS Formulation 2008 for the Thermodynamic Properties of Seawater. September 2008.
- **R12-08.** Release on the IAPWS Formulation 2008 for the Viscosity of Ordinary Water Substance (September 2008).
- **R11-07.** Release on the Ionization Constant of H₂O (August 2007) (This release replaces the corresponding release of 1980)
- **R10-06(2009).** Revised Release on the Equation of State 2006 for H₂O Ice Ih. September 2009. (This is a minor revision of the 2006 release)
- **R9-97.** Release on the Refractive Index of Ordinary Water Substance as a Function of Wavelength, Temperature and Pressure. September 1997. (This release replaces the corresponding release of 1991)
- **R8-97.** Release on the Static Dielectric Constant of Ordinary Water Substance for Temperatures from 238 K to 873 K and Pressures up to 1000 MPa. September 1997. (This release replaces the corresponding release of 1977)
- **R7-97(2012).** Revised Release on the IAPWS Industrial Formulation 1997 for the Thermodynamic Properties of Water and Steam (*The revision only relates to the extension of region 5 to 50 MPa*) (August 2007) (This is a revision of the 1997 release, which replaced the corresponding release of 1967).
NOTE: This release has been supplemented by additional "backward" equations for $p(h,s)$ in Regions 1 and 2, $T(p,h)$, $v(p,h)$, $T(p,s)$, $v(p,s)$ in Region 3, $p(h,s)$ in Region 3 with auxiliary equations for independent variables h and s , and $v(p,T)$ in Region 3.
- **R6-95(2016).** Revised Release on the IAPWS Formulation 1995 for the Thermodynamic Properties of Ordinary Water Substance for General and Scientific Use. September 2016. (This is a minor revision of the 1995 release, which replaced the corresponding release of 1984)
- **R5-85(1994).** Release on Surface Tension of Heavy Water Substance. September 1994. (This is a revision of the 1985 Release)

- **R4-84(2007).** Revised Release on Viscosity and Thermal Conductivity of Heavy Water Substance. August 2007. (This is a revision of the 1984 Release)
- **R2-76(2014).** Release on Values of Temperature, Pressure and Density of Ordinary and Heavy Water Substances at their Respective Critical Points. September 1992. (This is a revision of the 1983 Release)
- **R1-76(2014).** Revised Release on Surface Tension of Ordinary Water Substance. June 2014. (This is a minor revision of the 1994 revision of the 1976 Release)

CURRENT IAPWS SUPPLEMENTARY RELEASES (June 2024)

- **SR7-09.** Supplementary Release on a Computationally Efficient Thermodynamic Formulation for Liquid Water for Oceanographic Use. September 2009.
- **SR6-08(2011).** Revised Supplementary Release on Properties of Liquid Water at 0.1 MPa. September 2011). (This is a revision of the 2008 Supplementary Release).
- **SR5-05(2016).** Revised Supplementary Release on Backward Equations for Specific Volume as a Function of Pressure and Temperature $v(p,T)$ for Region 3 of the IAPWS Industrial Formulation 1997 for the Thermodynamic Properties of Water and Steam. June 2014. (This is a revision of the 2005 Supplementary Release).
NOTE: This Supplementary Release provides additional "backward" equations designed to accompany the IAPWS Industrial Formulation 1997.
- **SR4-04(2014).** Revised Supplementary Release on Backward Equations $p(h,s)$ for Region 3, Equations as a Function of h and s for the Region Boundaries, and an Equation $T_{\text{sat}}(h,s)$ for Region 4 of the IAPWS Industrial Formulation 1997 for the Thermodynamic Properties of Water and Steam. June 2014. (This is a revision of the 2004 Supplementary Release).
NOTE: This Supplementary Release provides additional "backward" equations designed to accompany the IAPWS Industrial Formulation 1997.
- **SR3-03(2014).** Revised Supplementary Release on Backward Equations for the Functions $T(p,h)$, $v(p,h)$, and $T(p,s)$, $v(p,s)$ for Region 3 of the IAPWS Industrial Formulation 1997 for the Thermodynamic Properties of Water and Steam. June 2014. (This is a revision of the 2004 Revised Supplementary Release).
NOTE: This Supplementary Release provides additional "backward" equations designed to accompany the IAPWS Industrial Formulation 1997.
- **SR2-01(2014).** Revised Supplementary Release on Backward Equations for Pressure as a Function of Enthalpy and Entropy $p(h,s)$ to the IAPWS Industrial Formulation 1997 for the Thermodynamic Properties of Water and Steam. June 2014. (This is a revision of the 2001 Supplementary Release).
NOTE: This Supplementary Release provides additional "backward" equations designed to accompany the IAPWS Industrial Formulation 1997.
- **SR1-86(1992).** Revised Supplementary Release on Saturation Properties of Ordinary Water Substance. September 1992. (This is a revision of the 1986 Release).

CURRENT IAPWS GUIDELINES (June 2024)

- **G14-19.** Guideline on the Surface Tension of Seawater. October 2019.
- **G13-15.** Guideline on the Fast Calculation of Steam and Water Properties with the Spline-Based Table Look-Up Method (SBTL). July 2015.
- **G12-15.** Guideline on Thermodynamic Properties of Supercooled Water. July 2015.
- **G11-15.** Guideline on a Virial Equation for the Fugacity of H₂O in Humid Air. July 2015.
- **G10-15.** Guideline on the Thermal Conductivity of Seawater Vapor. July 2015.
- **G9-12.** Guideline on a Low-Temperature Extension of the IAPWS-95 Formulation for Water Vapor. October 2012.
- **G8-10.** Guideline on an Equation of State for Humid Air in Contact with Seawater and Ice, Consistent with the IAPWS Formulation 2008 for the Thermodynamic Properties of Seawater. July 2010.
- **G7-04.** Guideline on the Henry's Constant and Vapor-Liquid Distribution Constant for Gases in H₂O and D₂O at High Temperatures. September 2004. (This guideline replaces a gas solubility guideline issued in 1993 and a distribution constant guideline issued in 1998.)
- **G6-03.** Guideline on the Tabular Taylor Series Expansion (TTSE) Method for Calculation of Thermodynamic Properties of Water and Steam Applied to IAPWS-95 as an Example. August 2003.
- **G5-01(2020).** Guideline on the Use of Fundamental Physical Constants and Basic Constants of Water. September 2001.
NOTE: This Guideline is reviewed annually and updated as necessary. Latest update September 2020.
- **G4-01.** Guideline on the IAPWS Formulation 2001 for the Thermodynamic Properties of Ammonia-Water Mixtures. September 2001.
- **G3-00(2012).** Revised Guideline on the Critical Locus of Aqueous Solutions of Sodium Chloride. (This is a revision of the 2000 Guideline). October 2012.
- **G2-90(1994).** Guideline: "Solubility of Sodium Sulfate in Aqueous Mixtures of Sodium Chloride and Sulfuric Acid from Water to Concentrated Solutions, from 250°C to 350°C". (This is a revision of the 1990 Guideline). September 1994.
- **G1-90.** Guideline: "Electrolytic Conductivity (Specific Conductance) of Liquid and Dense Supercritical Water from 0°C to 800°C and Pressures up to 1000 MPa". May 1990.

CURRENT IAPWS ADVISORY NOTES (June 2024)

- **AN6-16.** Advisory Note No. 6: Relationship between Various IAPWS Documents and the International Thermodynamic Equation of Seawater – 2010 (TEOS – 10). September 2016.
- **AN5-13(2016).** Advisory Note No. 5: Industrial Calculation of the Thermodynamic Properties of Seawater. September 2013.
- **AN4-09.** Advisory Note No. 4: Roles of IAPWS and CIPM Standards for the Density of Water. September 2009.
- **AN3-07(2014).** Revised Advisory Note No. 3: Thermodynamic Derivatives from IAPWS Formulations. June 2014. (This is a revision of the 2007 Advisory Note)
- **AN2-04(2013).** Advisory Note No. 2: Role of Various IAPWS Documents Concerning the Thermodynamic Properties of Ordinary Water Substance (September 2004)
NOTE: This Advisory Note is reviewed annually and updated as necessary. Latest update September 2013.
- **AN1-03.** Advisory Note No. 1: Uncertainties in Enthalpy for the IAPWS Formulation 1995 for the Thermodynamic Properties of Ordinary Water Substance for General and Scientific Use (IAPWS-95) and the IAPWS Industrial Formulation 1997 for the Thermodynamic Properties of Water and Steam (IAPWS-IF97). August 2003).

IAPWS CERTIFIED RESEARCH NEEDS (ICRNS) (June 2024)

Active ICRNs

25. Corrosion Mechanisms that are Related to the Presence of Contaminants in Steam/Water Circuits Particularly Boiler Water. Issued June 2014. Initial expiration was June 2019. At 2019 meeting the EC approved an extension to 2024 as this is an active International Collaboration project. IAPWS Contact: W. Cook.
28. Thermophysical Properties of Metastable Steam and Homogeneous Nucleation. Issued September 2011 and June 2014. Expires June 2019. Contact: J. Hruby.
31. New Thermodynamic Data for Ordinary Water. Issued October 2019. Expires October 2024. Contacts: A. Harvey and J. Hruby.

IAPWS CERTIFIED RESEARCH NEEDS (ICRNS) (September 2018)

Closed and Expired ICRNs

1. Evaluation of Binary Nucleation Models. Issued September 1993. Closed August 2004. Closing Statement November 2005. IAPWS Contact: F. Sigon.
2. Solubility of Sodium Sulphate in Superheated Steam. Issued September 1993. Expired September 2001. IAPWS Contact: K. Daucik. Closing Statement, October 2001.
3. Solubility of Spinels in the Chemical Conditions of Nuclear Reactors. Issued September 1993. Expired September 1996. Closing statement prepared. IAPWS Contacts: D. You.
4. Interaction Between Sodium Salts (Phosphates, Sulfates, Silicates, Borates) and Transition Metal Oxides. Issued September 1993. Closed September 1996. IAPWS Contact: J. Stodola.
5. Origin, Behaviour, and Fate of Organics in the Power Cycle. Issued September 1993. Closing Statement September 2006. IAPWS Contact: E. Maughan.
6. Thermophysical Properties of Ammonia-Water Mixtures. Issued June 1994. Closed September 2002. IAPWS Contact: W. Parry. Closing Statement, July 2002.
7. Carryover Coefficients of Salts and Metal Contaminants in Boiler Water. Issued June 1994. Expired June 1997. Closed September 1999. IAPWS Contact: P. Tremaine.
8. Development of an Accurate External Reference Electrode for Use in High Temperature and High Pressure Aqueous Solutions. Issued August 1994. Expired August 1997. Closed September 1998. IAPWS Contact: S. Lvov.
9. Thermodynamic Models for Transition-Metal/Water Systems under Steam Generator Conditions. Issued September 1994. Closed September 2000. IAPWS Contact: P. Tremaine
10. pH Measurements and Potentiometric Studies of Supercritical Aqueous Solutions. Issued May 1996. Extended to September 2009. IAPWS Contacts: S. Lvov and D. Palmer. Closed in September 2011 with a Closure Statement.
11. Properties of Salts in Steam. Issued May 1996. Closed September 2001. IAPWS Contacts: D. Palmer and R. Fernandez-Prini. No Closing Statement.
12. Kinetics of the Oxygen and Hydrogen Electrode Reactions in Subcritical and Supercritical Aqueous Systems. Issued September 1998. Closed September 2001. IAPWS Contacts: S. Lvov and D. Macdonald. No Closing Statement.
13. Surface Tension of Aqueous Solutions. Issued September 1998. Extended to September 2009. Closing Statement: September 2009. IAPWS Contacts: T. Nemeč and F. Marsik.
14. Thermophysical Properties of Humid Air and Combustion-Gas Mixtures. Issued July 2002. Extended to September 2011. Closing Statement September 2012. IAPWS Contacts R. Span and M. Hiegemann.

15. Thermodynamic Properties of Metastable Steam. Issued July 2002. Expires September 2011. IAPWS Contact: B. Rukes. July 2010 to be modified by TPWS to include Homogeneous Nucleation by September 2011. Closing Statement September 2011.
16. Thermophysical Properties of Seawater. Issued August 2007. Revised July 2011 and June 2014. Expired June 2019. At 2021 EC Meeting this was revised to September 2022. At 2022 EC Meeting TPWS appointed Hrubý and Pawlowicz as a Task Group to bring a recommendation to the 2023 IAPWS meeting for a new ICRN. At 2023 IAPWS meeting TPWS decided a new ICRN will be developed once new SCSW officers are appointed. Original IAPWS Contact was R. Pawlowicz.
17. Research on Amines for the Power Industry. Originally issued July 2010. Expired September 2013.
18. Decomposition of Ion Exchange Resins. Issued September 2006. Expires September 2009. IAPWS Contact: K. Daucik. Closing Statement 22nd July 2010.
19. Improved Coolant Sampling and Analysis of Low Concentration Metals (Fe, Cu, Co, etc.). Issued September 2006. Expired September 2009. ICRN extended to 2014. Expired October 2014. Closing Statement October 2014. IAPWS Contact: D. Lister.
20. Sensors for use at Elevated Temperature in the Plant Cycle of the Power Industry. Issued September 2006. Original Expired September 2009. PCC WG revised. Revision Expired September 2014. Closing Statement December 2014. IAPWS Contacts: S. Uchida and D. Lister.
21. Thermophysical Properties Associated with Ultra-supercritical Coal-Fired Steam Generators. Issued September 2009. Expired September 2012. Closing statement October 2012. IAPWS Contact: D. Palmer, B. Dooley and A. Harvey.
22. Steam Chemistry in Turbine Phase Transition Zone. Issued July 2010. Initial expiration September 2013. At 2014 Meetings EC approved extension for one year to June 2015. At 2017 meeting ICRN was finalized with an expiration date of September 2019. At the 2019 meeting a closing statement was planned but was not developed. IAPWS Contact was M. Stastny.
23. Dew Point for Flue Gas of Power Plant Exhaust. Issued September 2008. Expires September 2011. Revision September 2011, Expired September 2012. Closing statement October 2012. IAPWS Contact: N. Okita.
24. Thermal Conductivity of H₂O at Low Pressures and High Temperatures. Issued September 2009. Extended and Expired June 2015. IAPWS Contacts: A. Harvey.
26. Behaviour of Aluminum in the Steam/Water Cycle of Power Plants. Issued September 2011 and June 2014. Original expiration was June 2019. At 2019 meeting ICRN was closed. Closing statement was needed. Contacts: R. Svoboda and M. Rziha.
27. Thermodynamic Properties of Humid Gases and CO₂-Rich Mixtures. Issued September 2011. Expired September 2014. IAPWS Contacts: R. Span and A. Harvey.
29. Resolving Uncertainties in Coolant Sampling for Low-Concentration Metals (Fe, Cu, Co, etc.). Planned issue date: 2014. At 2017 meeting ICRN was finalized with an expiration date of September 2021. ICRN was never issued. Contact was D. Lister.

30. Thermodynamic Properties of Supercooled Water. Issued July 2015. Original expiration July 2020. At 2021 EC Meeting ICRN was closed. A closing statement was planned but not developed. A new ICRN will be developed and discussed at 2023 meeting. Contact was originally O. Hellmuth but new Task Force will be formed in 2023.

CURRENT IAPWS TECHNICAL GUIDANCE DOCUMENTS (TGD) (June 2024)

- **TGD11-19.** Application of Film Forming Substances in Industrial Steam Generators. October 2019.
- **TGD10-19.** Chemistry Management in Generator Water Cooling during Operation and Shutdown. October 2019.
- **TGD9-18.** Air In-leakage in Steam–Water Cycles. September 2018.
- **TGD8-16.** Application of Film Forming Amines in Fossil, Combined Cycle, and Biomass Power Plants. September 2016.
- **TGD7-16.** HRSG High Pressure Evaporator Sampling for Internal Deposit Identification and Determining the Need to Chemical Clean. September 2016.
- **TGD6-13(2014).** Corrosion Product Sampling and Analysis. November 2013. (This 2014 TGD includes editorial revisions of the 2013 TGD].
- **TGD5-13.** Steam Purity for Turbine Operation. September 2013.
- **TGD4-11(2015).** Phosphate and NaOH Treatments for the Steam-Water Circuits of Drum Boilers of Fossil and Combined Cycle/HRSG Power Plants. September 2015. (This is a revision of the 2011 TGD].
- **TGD3-10(2015).** Volatile Treatments for the Steam-Water Circuits of Fossil and Combined Cycle/HRSG Power Plants. July 2015. (This is a revision of the 2010 TGD].
- **TGD2-09(2015).** Instrumentation for Monitoring and Control of Cycle Chemistry for the Steam-Water Circuits of Fossil-Fired and Combined Cycle Power Plants. July 2015. (This is a minor revision of the 2009 TGD].
- **TGD1-08.** Procedures for the Measurement of Carryover of Boiler Water and Steam (September 2008).