CCT member and observer Activity Report

Period: January to December 2021

Institute: INRiM – Istituto Nazionale di Ricerca Metrologica (Italy)

State economy:

Number of persons involved in thermometry of the institute: 23

Short summary of research and development: Development of primary thermometry methods, e.g. acoustic gas thermometry (AGT) and refractive index gas thermometry (RIGT) to implement the new definition of the kelvin and determination of the differences (T-T_{90}) between the thermodynamic temperature and ITS-90 in the range between 14 K and 430 K; Study of the reproducibility of eutectic metal-carbon (M-C) fixed points; Maintenance and development of the fixed points of the International temperature scale of 1990 (ITS-90); Research activities to extend the contribution of the thermal metrology community to climate science and meteorology; In hygrometry, extension of dew/frost point measurement capabilities by the realization of humid gas generators between −105 °C and 180 °C and, in pressure up to 0.5 MPa with different carrier gases; Determination of thermophysical properties, like speed of sound, heat capacity, vapor pressure of fluid substances (e.g. water, seawater, new refrigerants, liquid natural gas, biofuels, ..); Design and realization of thermal apparatus in support of fundamental research (e.g. atomic and quantum physics); Participation and piloting of international Key Comparisons in Temperature and Humidity; Dissemination and services related to NMI role: calibrations – Inter-Laboratory Comparisons (ILC) – industrial testing and investigations – technical workshops – training; Development of new CMCs for thermometry and humidity; Participation into the working groups and Committees of BIPM and Euramet including Chairmanship of the WG Environment (CCT-WG-Env), of the newly formed Air TG-Env-AirT and participation working groups Non-Contact Thermometry (CCT-WG-NCTh); Thermophysical Quantities (CCT-TG-ThQ); Body Temperature Measurement (CCT TG-NCTH-BTM); ; Collaboration with the World Meteorological Organization (WMO) with INRiM staff contributing with membership and chairmanship to several WMO expert teams and committees.

Short summary of recent comparison activity:

- CCT-K8: Key comparison of realizations of local scales of dew-point temperature of humid gas; INRIM measurements completed;
- CCT K7 2021: Key Comparison of Triple Point of Water cells will likely be abandoned by INRiM in 2022 due to rupture of transfer standard;
- CCT K9: Key Comparison of SPRT calibration between Ar and Zn fixed points; approval of Draft A and preparation of results for publication
- CCT K2.2: Bi-Lateral Key Comparison between INRiM and NIM on realizations of the ITS-90 from 24.5 K to 273.16 K: waiting for completion of NIM measurement activities;
- EURAMET T.K8, Key Comparison of high dew-point temperatures: awaiting for final report;
- EURAMET.T-K9: Regional key comparison: follows corresponding CCT K9;
- coordination of the WMO ILC on temperature, pressure and humidity: the ILC is now being organized in the WMO South American and African Regional Instrument Centres.

Short summary of other activities: Several international and national research projects are running with the contribution of or the coordination by INRiM. These include:

- EMPIR 20IND02 (2021-2024) Metrology for trace water in ultra-pure process gases "PROMETH2O" - INRiM coordination. The project will develop a range of optical methods to measure amount fractions of water down to 5 ppb for gases other than nitrogen, and a primary method down to 50 ppb to validate chilled-mirror hygrometers down to –105 ° C.
- EMPIR 19SIP03 (2020-2023) Climate Reference Station "CRS" – INRiM coordination – study of best instrumentation for completing a Climate Reference Station for the future GCOS Surface Reference Network. A test site field installation, together with the INRiM laboratories will provide a research infrastructure for the project and initiative.
- EMPIR 18NRM03 (2019-2022) Calibration and accuracy of non-catching instruments to measure liquid/solid atmospheric precipitation "INCIPIT" – INRiM coordination. In 2021 the prototype of a rain generator was concluded by DTI and tests have been made at INRiM to evaluate the drops dispersion after more than 10 m of vertical falling trajectories. The project will study and propose best practice for the calibration of non-catching rain gauges;
- EMPIR 20IND27 (2021-2024) Metrology for decarbonisation of the gas grid "Decarb". INRiM contributes by thermodynamic property measurements of natural gas and biogas fluid mixtures
- EMPIR 19SIP03 (2020-2023) Increasing the comparability of extreme air temperature measurements for meteorology and climate studies "COAT". INRiM is supporting the installation of a field site for the intercomparison of thermometers and solar shields in the Arctic. In cooperation with CEM and the Italian Polar Sciences Institute, work is ongoing for hosting the WMO intercomparison in polar conditions.
- EMPIR 18SIB02 (2019-2022) Realising the redefined kelvin "Real-K". INRiM contributes by AGT and RIGT thermodynamic temperature measurements, study of eutectic metal-carbon fixed points and evaluation of the ITS-90 Type 3 non-uniqueness;
- EMPIR 18SIB04 (2019-2022) Towards quantum-based realisations of the pascal "QuantumPascal". Among other activities, INRiM contributes by developing a primary pressure standard based on RIGT primary thermometers;
- EMPIR 17IND12 (2018-2021) Metrology for the Factory of the Future "Met4FoF". INRiM contributes by development of next generation process thermometry, photonics and phosphor-based sensors, to enhance manufacturing industrial processes
- EMPIR 17IND04 (2018-2021) Enhancing process efficiency through improved temperature measurement 2 "EMPRESS2" INRiM contributes by Development and traceable calibration of phosphor thermometry
- H2020 MIDAS (2021-2024) – Modular and Integrated Digital Probe for SAT Aircraft Air Data System. Partnership of INRiM with Politecnico di Torino for the characterization of prototype sensor systems for small aircraft. Sensors are being tested under a wide range of variability of the quantities of interest: temperature, pressure (altitude), airspeed and angles.
- EURAMET P1459 (2018-2022) Air Temperature Metrology "ATM" INRIM coordinates this EURAMET project aiming at proposing guidelines for the calibration of thermometers in air. The associated three-loops ILC was concluded in 2021;
- Participation in Euramet Project 1123: On site Peer Review INRiM, CEM, IPQ

Link to bibliography or list of bibliography (last 5 years):

2021

- Gugliandolo G., Naishadham K., Neri G., Fernicola V., Donato N., "A Novel Sensor-Integrated Aperture Coupled Microwave Patch Resonator for Humidity Detection", *IEEE Trans. Instr. Meas.* **70**, 9506611 (2021)
- Gugliandolo, G.; Tabandeh, S.; Rosso, L.; Smorgon, D.; Fernicola, V., "Whispering Gallery Mode Resonators for Precision Temperature Metrology Applications." *Sensors* **21**, 2844 (2021).
- Beltramino G., Rosso L., Cuccaro R., Fernicola V., "Vapour pressure measurements of liquid heavy water in the temperature range between 256 K and 286 K", *J. Chem. Thermodynam.* **161**, 106510 (2021)
- G. Lopardo, F. Bertiglia, M. Bertinetti, A. Barbone, D. Giraudi, R. Dematteis, L. Gianfrani, "A thermostatic chamber for doppler-broadening thermometry of mercury vapors" *Measurement* **173**, 108594 (2021).
- A. Merlone, "Thermal metrology for climate: a review of projects, activities and open issues ". *Meas. Sci. Technol.* **32**, 102001 (2021)
- G. Coppa, A. Quarello, G. Steeneveld, N. Jandrić, A. Merlone, "Metrological evaluation of the effect of the presence of a road on near-surface air temperatures", *Int. J. Climatol.* **41**, 3705-3724 (2021).
- M. E. Paredes Quintanilla, S. Abdunabiev, M. Allegretti, A. Merlone, C. Musacchio, E. G. A. Pasero, D. Tordella, F. Canavero, " Innovative Mini Ultralight Radioprobes to Track Lagrangian Turbulence Fluctuations within Warm Clouds: Electronic Design", *Sensors* **21**, 13512021 (2021).
- L. G. Lanza, A. Merlone, A. Cauteruccio, E. Chinchella, M. Stagnaro, M. Dobre, M. C. Garcia Izquierdo, J. Nielsen, H. Kjeldsen, Y. A. Roulet, G. Coppa,C. Musacchio, C. Bordianu, M. Parrondo, "Calibration of non-catching precipitation measurement instruments: A review", *Meteorol. Appl.* **28,** e2002 (2021)
- Musacchio C., Coppa G., Begeš G., Hofstätter-Mohler C., Massano L., Nigrelli G., Sanna F., Merlone, A., "Effect of snow-covered ground albedo on the accuracy of air temperature measurements", *Atmos. Meas. Tech.* **14**, 6195–6212 (2021)
- G. Cavuoto, S. Lago, P. A. Giuliano Albo, "Towards a new transfer standard for speed of sound measurements in liquids at cryogenic temperatures", *Measurement* **180** 109526 (2021).
- D. Madonna Ripa, D. Imbraguglio, C. Gaiser, P. P. M. Steur, D. Giraudi, M. Fogliati, M. Bertinetti, G. Lopardo, R. Dematteis, R. M. Gavioso, "Refractive index gas thermometry between 13.8 K and 161.4 K" *Metrologia* **58** (2021) 025008.
- C. Pan, F. Sparasci, H. Zhang, P. Gambette, M. Plimmer, D. Imbraguglio, R. M. Gavioso, M. R. Moldover, B. Gao, L. Pitre, "Acoustic measurement of the triple point of neon T_{Ne} and thermodynamic calibration of a transfer standard for accurate cryogenic thermometry, *Metrologia* **58** 045006 (2021).
- C. Lamberti, S. Nebbia, S. Antoniazzi, S. Cirrincionea, E. Marengob, M. Manfredi, D. Smorgon, G. Montid, A. Faccio, M. G. Giuffrida, R. Balestrini, L. Cavallarin, "Effect of hot air and infrared roasting on hazelnut allergenicity", *Food Chem.* **342**, 128174(2021).
- J. V. Pearce, R. L. Rusby, K. Yamazawa, S. Rudtsch, L. Iacomini, G. Lopardo, D. R. White, W. L. Tew "Guide on Secondary Thermometry: Industrial Platinum Resistance Thermometers", BIPM CCT Guidebooks: Guide to Secondary Thermometry (2021).

2020

- G. Cavuoto, S. Lago, P.A. Giuliano Albo, D. Serazio, "Speed of sound measurements in liquid methane (CH4) at cryogenic temperatures between (130 and 162) K and at pressures up to 10 MPa" *J. Chem. Thermodynam*. **142** 106007 (2020).
- Beltramino G., Rosso L., Cuccaro R., Tabandeh S., Smorgon D., Fernicola V., "Accurate vapor pressure measurements of supercooled water in the temperature range between 252 K and 273 K", *J. Chem. Thermodynam.* **141**, 105944 (2020).
- Rosso L., Tabandeh S., Beltramino G., Fernicola V., "Validation of phosphor thermometry for industrial surface temperature measurements", *Meas. Sci. Technol.* **31**, 034002 (2020).
- Alberghini M., Morciano M., Fasano M., Bertiglia F., Fernicola V., Asinari P., Chiavazzo E., "Multistage and passive cooling process driven by salinity difference", *Sci. Adv.* **6**, eaax5015 (2020)
- Viani C., Chiarle M., Paranunzio R., Merlone A., Musacchio C., Coppa G., Nigrelli G., "An integrated approach to investigate climate-driven rockfall occurrence in high alpine slopes: the Bessanese glacial basin, Western Italian Alps", *J. Mt. Sci.*, **17**, 2591–2610 (2020)
- T. C. Basso, G. Perotto, C. Musacchio, A. Merlone, A. Athanassiou, D. Tordella, "Evaluation of Mater Bi and Polylactic Acid as materials for biodegradable innovative mini-radiosondes to track small scale fluctuations within clouds", *Mater. Chem. Phys.* **253**, 123411 (2020)
- D. Imbraguglio, P. P. M. Steur, F. Sparasci, "Comparison of ITS-90 realizations from 13 K to 273 K between LNE-CNAM and INRIM" *Measurement* **166**, 108225 (2020).
- S. Lago, P. A. Giuliano Albo, G. Cavuoto, "Speed of sound measurements in deuterium oxide (D_2O) at temperatures between (276.97 and 363.15) K and at pressures up to 210 MPa", *Fluid Phase Eq*. **506**, 112401 (2020)
- C. Pan, H. Chen, D. Han, H. Zhang, M. Plimmer, D. Imbraguglio, E. Luo, B. Gao, L. Pitre, "Numerical and Experimental Study of the Hydrostatic Pressure Correction in Gas Thermometry: A Case in the SPRIGT" *Int. J. Thermophys.* **41**:108 (2020).

- P. P. M. Steur, F. Pavese, "The ITS-90: A review of the evolution of the cryogenic ranges since 1990 and a view of its future after the new kelvin definition" *Measurement* **159**, 107792 (2020).
- P. P.M. Steur, I. Yang, D. Giraudi, F. Pavese, "Amount concentration of Ar in O_2 obtained by means of thermal analysis of certified mixtures at the a–b transition of O_2, and preliminary confirmation of a new finding", *J. Chem. Thermodynam.* **141**, 105934 (2020).
- P. P.M. Steur, I. Yang, F. Pavese, "The Effect of Argon Content on the *β–γ* Transition of Oxygen", *Int. J. Thermophys.* **41**:7 (2020)
- R. J. Dirksen, G. E. Bodeker, P. W. Thorne, A. Merlone, T. Reale, J. Wang, D. F. Hurst, B. B. Demoz, T. D. Gardiner, B. Ingleby, M. Sommer, C. von Rohden, T. Leblanc, "Progress in managing the transition from the RS92 to the Vaisala RS41 as the operational radiosonde within the GCOS Reference Upper-Air Network", *Geosci. Instrum. Methods Data Syst.* **9**, 337-355 (2020).
- A. Merlone, G. Coppa, C. Bassani, G. Bonnier, F. Bertiglia, S. Dedyulin, J-O. Favreau, V. Fernicola, J. van Geel, E. Georgin, M. Gotoh, S. Krenek, L. Iacomini, W. Joung, G. Machin, P. Marcarino, H. McEvoy, C. Musacchio, J. V. Pearce, S. Rudtsch, M. Sadli, J. Tamba, D. Woods, X. Yan, "Gas-controlled heat pipes in metrology: more than 30 years of technical and scientific progresses" *Measurement* **164**, 108103 (2020).
- A. Merlone, F. Sanna, G. Coppa, L. Massano, C. Musacchio, "Transportable system for on-site permafrost temperature sensors calibration", *Permafr. Periglac. Process.* **31**, 610-620 (2020)
- P. Pavlasek, A. Merlone, F. Sanna, G. Coppa, C. G. Izquierdo, L. Soos, S. Duris, "Determination of automatic weather station self-heating originating from accompanying electronics", *Meteorol. Appl.* **27**, e1844 (2020)
- Kowal, A., Merlone, A., Sawinski, T., "Long-term stability of meteorological temperature sensors", *Meteorol. Appl.* **27**, e1795 (2020)
- Del Campo D., Abdelaziz Y., Anagnostou M., Arifovic N., Bergerud R. A., Bojkovski J., Ciocarlan E., Edler F., Elliot C., Hathela O., Hodzic N., Holmsten M., Iacomini L., Kozicki M., Nedialkov S., Sadli M., Simic S., Strnad R., Turzó-András E., "Calibration of thermocouples from 419,527 °C (freezing point of Zn) up to 1492 °C (melting point of the Pd-C eutectic), by the temperature fixed point and comparison methods", *Metrologia* **57**, 1–121, 03006 , (2020)

2019

- Samadelli M., Zink A. R., Roselli G., Gabrielli S., Tabandeh S., Fernicola V. C., "Development of passive controlled atmosphere display cases for the conservation of cultural assets", *J. Cultur. Heritage* **35**, 145–153 (2019).
- Cortellessa G., Arpino F., Dell'isola M., Ficco G., Iacomini L., Fernicola V., Bertiglia F., "Experimental and numerical analysis in heat flow sensors calibration", *J. Therm. Anal. Calorim.* **138**, 2901–2912 (2019).
- A. Merlone, H. Al-Dashti, N. Faisal, R. S. Cerveny, S. AlSarmi, P. Bessemoulin, M. Brunet, F. Driouech, Y. Khalatyan, T. C. Peterson, F. Rahimzadeh, B. Trewin, M. M. A. Wahab, S. Yagan, G. Coppa, D. Smorgon, C. Musacchio, D. Krahenbuh, "Temperature extreme records: World Meteorological Organization metrological and meteorological evaluation of the 54.0 °C observations in Mitribah, Kuwait and Turbat, Pakistan in 2016/2017", *Int. J. Climatology* **39**, 5154-5169 (2019).
- Cortellessa G., Iacomini L., "A novel calibration system for heat flow meters: Experimental and numerical analysis", *Measurement* **144**, 115–117 (2019).
- R. M. Gavioso, D. Madonna Ripa, P. P. M. Steur, R. Dematteis, D. Imbraguglio, "Determination of the thermodynamic temperature between 236 K and 430 K from speed of sound measurements in helium", *Metrologia* **56**, 045006 (2019).
- M. Le Menn, P. A. Giuliano Albo, S. Lago, R. Romeo, F. Sparasci, "The absolute salinity of seawater and its measurands", *Metrologia* **56**, 015005 (2019).
- D. Lozano-Martín, D. Madonna Ripa, R. M. Gavioso, "Speed of sound in gaseous cis-1,3,3,3-tetrafluoropropene (R1234ze(Z)) between 307 K and 420 K", *Int. J. Refrig.* **100**, 37-47 (2019)
- R. Romeo, P.A. Giuliano Albo, S. Lago, "Density of standard seawater by vibrating tube densimeter: Analysis of the method and results ", *Deep Sea Res. I* **154**, 103157 (2019).
- P. M. C. Rourke, C. Gaiser, B. Gao, D. Madonna Ripa, M. R. Moldover, L. Pitre, R. J. Underwood, "Refractive-index gas thermometry" *Metrologia* **56**, 032001 (2019).
- P. P. M. Steur, I. Yang, J. S. Kim, T. Nakano, K. Nagao, F. Pavese, "An inter-comparison of isotopic composition of neon *via* chemical assays and thermal analyses (IUPAC Technical Report)", *Pure Appl. Chem.* **91**, 1869-1882 (2019).
- P. P. M. Steur, P. M. C. Rourke, D. Giraudi, "Comparison of xenon triple point realizations", *Metrologia* **56**, 015008 (2019).
- C. Musacchio, G. Coppa, A. Merlone, An experimental method for the evaluation of snow albedo effect on near surface air temperature measurements, *Meteorol. Appl.* **26**, 161-170, (2019).

2018

- M. Heinonen, S. Bell, B. Il Choi, G. Cortellessa, V. Fernicola, E. Georgin, D. Hudoklin, G. V. Ionescu, N. Ismail, T. Keawprasert, M. Krasheninina, R. Aro, J. Nielsen, S. O. Uz Aytekin, P. Österberg, J. Skabar, R. Strnad, "New Primary Standards for Establishing SI Traceability for Moisture Measurements in Solid Materials", *Int. J. Thermophys*., **39**, 20 (2018)
- D. Šestan, D. Smorgon, P. Rothmund, L. Iacomini, K. Šariri, V. Fernicola, D. Zvizdi, N. Hodži, "Development and preliminary investigation of a modular chamber for calibration of relative humidity instruments", *J. Phys. Conf. Ser.* **1065**, 122017 (2018)

- N. Hodži, S. Ohodarevi, N. Jandri, R. Strnad, D. Zvizdi, D. Šestan, V. Fernicola, D. Smorgon, L. Iacomini, S. Simic, D. Mac Lochlainn, N. Karaboce, S. Oguz Aytekin, J. Bojkovski, D. Hudoklin, O. Petrušova, T Vukicevic, "Improving emerging European NMIs' capabilities in humidity measurement", *J. Phys. Conf. Ser.* **1065**, 122019 (2018).
- H. McEvoy, M. J. Martin, A. Steiner, E. Schreiber, F. Girard, M. Battuello, M. Sadli, P. Ridoux, B. Gutschwager, J. Hollandt, A. Diril, Ö. Pehlivan, "Report on the measurement results for the EURAMET 658 extension: project to examine underlying parameters in radiance scale realisation", *Metrologia* **55**, 03001 (2018).
- Cuccaro R.; Rosso L., Smorgon D., Beltramino G.; Tabandeh S., Fernicola V. "Development of a low frost-point generator operating at sub-atmospheric pressure", *Meas. Sci. Technol.*, **29**, 054002 (2018).
- Pavlasek P., Palencar R., Duris S., Palencar J., Merlone A., Sanna F., Coppa G., "Determination of overall self-heating of automatic weather stations", *J. Phys. Conf. Ser.* **1065**, 192002 (2018).
- E. Fasci, H. Dinesan, L. Moretti, A. Merlone, A. Castrillo, L. Gianfrani, "Dual-laser frequency-stabilized cavity ring-down spectroscopy for water vapor density measurements", *Metrologia* **55**, 662-669 (2018).
- P. W. Thorne, H. J. Diamond, B. Goodison, S. Harrigan, Z. Hausfather, N. B. Ingleby, P. D. Jones, J. H. Lawrimore, D.H. Lister , A. Merlone, T. Oakley, M. Palecki, T. C. Peterson, M. de Podesta, C. Tassone, V. Venema, K. M. Willett, "Towards a global land surface climate fiducial reference measurements network", *Int. J. Climatol.* **38**, 2760-2774, (2018).
- Sanna F., Calvo A., Deboli R., Merlone, A., "Vineyard diseases detection: a case study on the influence of weather instruments' calibration and positioning", *Meteorol. Appl.* **25**, 228-235 (2018).
- Merlone A., Sanna F., Beges G., Bell S., Beltramino G., Bojkovski J., Brunet M., Del Campo D., Castrillo A., Chiodo N., Colli M., Coppa G., Cuccaro R., Dobre M., Drnovsek J., Ebert V., Fernicola V., Garcia-Benadí A., Garcia-Izquierdo C., Gardiner T., Georgin E., Gonzalez A., Groselj D., Heinonen M., Hernandez S., Högström R., Hudoklin D., Kalemci M., Kowal A., Lanza L., Miao P., Musacchio C., Nielsen J., Nogueras-Cervera M., Oguz Aytekin S., Pavlasek P., De Podesta M., Rasmussen M. K., Del-Río-Fernández J., Rosso L., Sairanen H., Salminen J., Sestan D., Šindelářová L., Smorgon D., Sparasci F., Strnad R., Underwood R., Uytun A., Voldan M., "The MeteoMet2 project – Highlights and results", *Meas. Sci. Technol.* **29**, 025802 (2018).
- J. Fischer, B. Fellmuth, C. Gaiser, T. Zandt, L. Pitre, F. Sparasci, M. D. Plimmer, M. de Podesta, R. Underwood, G. Sutton, G. Machin, R. M. Gavioso, D. Madonna Ripa, P. P. M. Steur, J. Qu, X. J. Feng, J. Zhang, M. R. Moldover, S. P. Benz, D. R. White, L. Gianfrani, A. Castrillo, L. Moretti, B. Darquié, E. Moufarej, C. Daussy, S. Briaudeau, O. Kozlova, L. Risegari, J. J. Segovia, M. C. Martín, D. del Campo, "The Boltzmann Project" *Metrologia* **55** R1–R20 (2018).
- Lago S., Giuliano Albo P.A., Brown J.S., Bertinetti M.,"High-Pressure Speed of Sound Measurements of trans-1-Chloro-3,3,3-trifluoropropene (R1233zd(E)) in Liquid Region for Temperature from (273.15 to 353.15) K", *J. Chem. Eng. Data* **63**, 4039–4045 (2018).
- Romeo R., Lago S., Giuliano Albo P. A., "Experimental densities of subcooled deuterium oxide at pressures up to 160 Mpa", *J. Chem. Phys.* **149**, 154503 (2018).

2017

- Beltramino G., Rosso L., Smorgon D., Fernicola V., "Vapor pressure measurements over supercooled water in the temperature range from -101 °C to +10-2 °C, *J. Chem. Thermodyn.* **105**, 159–164 (2017).
- Rolle F., Beltramino G., Fernicola V., Sega M., Verdoja A., "Metrologically Traceable Determination of the Water Content in Biopolymers: INRIM Activity", *Int. J. Thermophys.*, **38**, 36 (2017).
- Saba F., Fernicola V., Masoero M., Abramo S., "Experimental Analysis of a Heat Cost Allocation Method for Apartment Buildings", *Buildings* **7**, 20 (2017).
- Yu L., Zhang G., Fernicola V., Lu J. "Investigations on perturbations of microwave dielectric resonator thermometer", *Meas. Sci. Technol.*, **28**, 047001 (2017).
- J. O. Favreau, E. Georgin, B. Savanier, A. Merlone, "Implementation of a Water Heat Pipe at CETIAT", *Int. J. Thermophys.* **38**:185, (2017).
- Steur P.P.M., Yang I., Pavese, F., "Evidence for Argon Content in Pure Oxygen from Thermal Data, *Int. J. Thermophys.* **38**, 20 (2017)
- Pavese F., Szmyrka-Grzebyk A., Steur P.P.M., "The ITS-90 after definition of neon isotopic reference composition: Extent of the isotopic effect tested on previous inter-comparison results", *Int. J. Metrol. Qual. Eng.* **8**, 27 (2017).
- Romeo, R., Giuliano Albo, P.A., Lago, S., Brown, J.S., "Experimental liquid densities of cis-1,3,3,3-tetrafluoroprop-1-ene (R1234ze(Z)) and trans-1-chloro-3,3,3-trifluoropropene (R1233zd(E))", *Int. J. Refriger*. **79**, 176–182 (2017)