

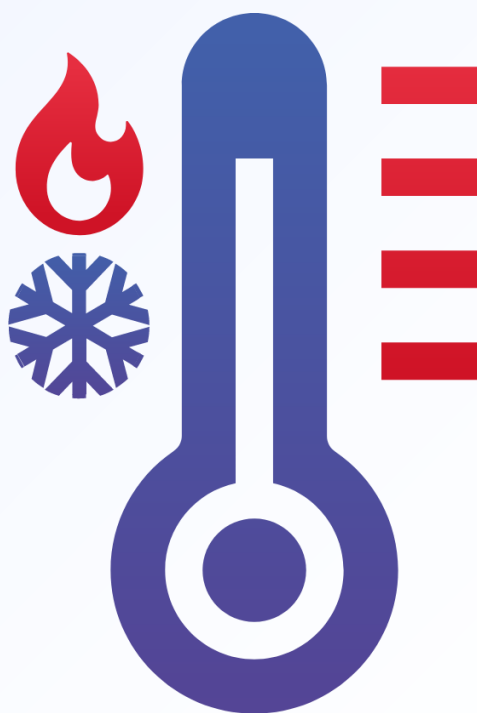
Vol. 45 No. 2 (2024)



# ARCHIVES OF THERMODYNAMICS

ISSN: 1231-0956

ISSN: 2083-6023 (Online)



Co-published by



**Institute of Fluid Flow Machinery**  
Polish Academy of Sciences



**Committee on Thermodynamics  
and Combustion**  
Polish Academy of Sciences



### Aims and Scope

The aim of the quarterly journal Archives of Thermodynamics (AoT) is to disseminate knowledge between scientists and engineers worldwide and to provide a forum for original research conducted in the field of thermodynamics, heat transfer, fluid flow, combustion and energy conversion in various aspects of thermal sciences, mechanical and power engineering. Besides original research papers, review articles are also welcome.

The journal scope of interest encompasses in particular, but is not limited to:

- Classical and extended non-equilibrium thermodynamics
- Thermodynamic analysis including exergy
- Thermodynamics of heating and cooling
- Thermodynamics of nuclear power generation
- Thermodynamics in defense engineering
- Advances in thermodynamics
- Experimental, theoretical and numerical heat transfer
- Thermal and energy system analysis
- Renewable energy sources including solar energy
- Secondary fuels and fuel conversion
- Heat and momentum transfer in multiphase flows
- Nanofluids
- Energy transition
- Advanced energy carriers
- Energy storage and efficiency
- Energy in buildings
- Hydrogen energy
- Combustion and emissions
- Turbomachinery
- Thermal and energy system analysis
- Integrated energy systems
- Distributed energy generation
- Thermal incineration of wastes
- Waste heat recovery.

### Supervisory Editors

- T. Bohdal, Koszalin University of Technology, Poland
- M. Lackowski, Institute of Fluid Flow Machinery, Gdańsk, Poland

### Honorary Editor

- J. Mikielwicz, Institute of Fluid Flow Machinery, Gdańsk, Poland

### Editor-in-Chief

- P. Ochoń, Cracow University of Technology, Cracow, Poland

### Guest Editor

- J. Wajs, Gdańsk University of Technology, Gdańsk, Poland

### Section Editors

- P. Lampart, Institute of Fluid Flow Machinery, Gdańsk, Poland
- S. Polesek-Karczewska, Institute of Fluid Flow Machinery, Gdańsk, Poland
- I. Szczygiał, Silesian University of Technology, Gliwice, Poland
- A. Szlę, Silesian University of Technology, Gliwice, Poland

### Technical Editors

- J. Frączak, Institute of Fluid Flow Machinery, Gdańsk, Poland
- S. Łopata, Institute of Fluid Flow Machinery, Gdańsk, Poland

### Members of Programme Committee

- P. Furmański, Warsaw Univ. Tech., Poland
- J. Badur, Inst. Fluid Flow Mach., Gdańsk, Poland
- T. Chmielniak, Silesian Univ. Tech., Gliwice, Poland
- D. Kardaś, Inst. Fluid Flow Mach., Gdańsk, Poland
- S. Pietrowicz, Wrocław Univ. Sci. Tech., Poland
- R. Kobyłcki, Częstochowa Univ. Tech., Poland
- J. Wajs, Gdańsk Univ. Tech., Poland

### International Advisory Board

- J. Bataille, Ecole Centr. Lyon, France
- A. Bejan, Duke Univ., Durham, USA
- W. Błasiak, Royal Inst. Tech., Stockholm, Sweden
- G.P. Celata, ENEA, Rome, Italy
- L.M. Cheng, Zhejiang Univ., Hangzhou, China
- M. Colaco, Federal Univ. Rio de Janeiro, Brazil
- J.M. Delhay, CEA, Grenoble, France
- M. Giot, Univ. Catholique Louvain, Belgium
- K. Hooman, Univ. Queensland, Australia
- D. Jackson, Univ. Manchester, UK
- D.F. Li, Kunming Univ. Sci. Tech., China
- K. Kuwagi, Okayama Univ. Science, Japan
- J.P. Meyer, Univ. Pretoria, South Africa
- S. Michaelides, Texas Christian Univ., USA
- M. Moran, Ohio State Univ., USA
- W. Muschik, Tech. Univ., Berlin, Germany
- I. Müller, Tech. Univ., Berlin, Germany
- H. Nakayama, JAEA, Japan
- S. Nizetic, Univ. Split, Croatia
- H. Orlande, Federal Univ. Rio de Janeiro, Brazil
- M. Podowski, Rensselaer Polyt. Inst., USA
- R.V. Rao, Sardar Vallabhbhai Nat. Inst. Techn., India
- A. Rusanov, Inst. Mech. Eng. Probl., Kharkiv, Ukraine
- A. Vallati, Sapienza Univ. Rome, Italy
- M.R. von Spakovsky, Virginia Polyt. Inst., USA
- H.R. Yang, Tsinghua Univ., Beijing, China

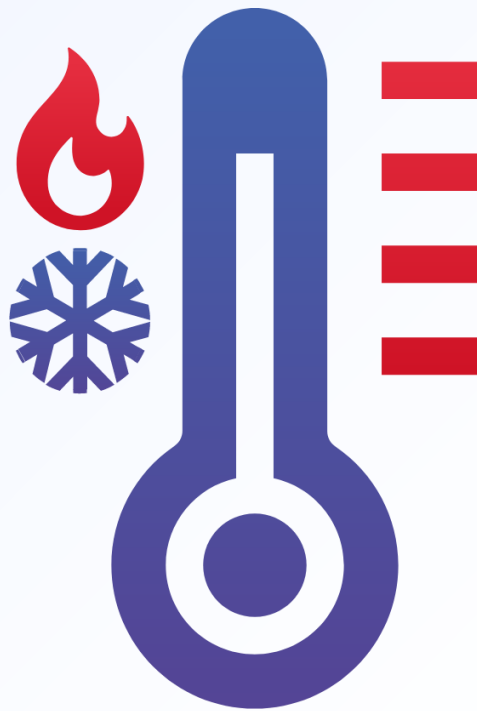
Vol. 45 No. 2 (2024)



# ARCHIVES OF THERMODYNAMICS

ISSN: 1231-0956

ISSN: 2083-6023 (Online)



Co-published by

**Institute of Fluid Flow Machinery**

Polish Academy of Sciences

**Committee on Thermodynamics and Combustion**

Polish Academy of Sciences



**Editorial Office**

IMP PAN Publishers

Institute of Fluid Flow Machinery, Fiszerza 14, 80-231 Gdańsk, Poland,

Phone: (+48) 58-341-12-71 int. 230, e-mail: redakcja(at)imp.gda(.)pl

<https://www.imp.gda.pl/archives-of-thermodynamics/>

Journals PAS – Electronic Library Polish Academy of Sciences

<https://journals.pan.pl/ather>**Subscription outside Poland**

From 2024, Archives of Thermodynamics appear only in electronic version as an open access journal. However, printed archive volumes or issues are still available. The price of a full volume outside Poland is **120 EUR**. The price of a single issue is **30 EUR**. Archived volumes or issues are available on request. Orders should be sent directly to IMP PAN Publishers:

Institute of Fluid-Flow Machinery,

Fiszerza 14, 80-231 Gdansk, Poland,

e-mail: redakcja(at)imp.gda.pl or jfrk(at)imp.gda(.)pl or jrybka(at)imp.gda(.)pl.

Payments should be transferred to the bank account of IMP PAN:

IBAN 28 1130 1121 0006 5498 9520 0011 at Bank Gospodarstwa Krajowego; Code SWIFT: GOSKPLPW.

**Prenumerata w Polsce**

Od 2024, czasopismo ukazuje się tylko w formie elektronicznej otwartej. Osiągalne są jednak wydania papierowe archiwalne. Cena pojedynczego numeru wynosi **50 PLN**. Cena rocznika **200 PLN**. Zamówienia z określeniem numeru (rocznika), nazwiskiem i adresem odbiorcy należy kierować bezpośrednio do Wydawcy:

Instytut Maszyn Przepływowych PAN

ul. Fiszerza 14, 80-231 Gdańsk,

e-mail: redakcja(at)imp.gda(.)pl lub jfrk(at)imp.gda(.)pl lub jrybka(at)imp.gda(.)pl.

Wpłaty prosimy kierować na konto Instytutu Maszyn Przepływowych PAN:

nr 28 1130 1121 0006 5498 9520 0011 w Banku Gospodarstwa Krajowego.

**Articles in Archives of Thermodynamics are abstracted and indexed within:**

Applied Mechanics Reviews • Arianta • Baidu Scholar • BazTech • Cabell's Directory • Celdes • Chemical Abstracts Service (CAS) – CAPlus • CNKI Scholar (China National Knowledge Infrastructure) • CNPIEC • EBSCO (relevant databases) • EBSCO Discovery Service • Elsevier – SCOPUS • ESCI (Emerging Sources Citation Index) • Genamics JournalSeek • Google Scholar • Inspec • Index Copernicus • J-Gate • Journal TOCs • Naviga (Softweco) • Paperbase • Pirabase • POL-index • Polymer Library • Primo Central (ExLibris) • ProQuest (relevant databases) • ReadCube • Referativnyi Zhurnal (VINITI) • SCImago (SJR) • Summon (Serials Solutions/ProQuest) • TDOne (TDNet) • TEMA Technik und Management • Ulrich's Periodicals Directory/ulrichsweb • WorldCat (OCLC)

**ISSN 1231-0956****ISSN 2083-6023 (Online)****Copyright** © 2024 by the Authors under license CC BY 4.0.

Publication funding of this journal is provided by resources of the Polish Academy of Sciences and the Institute of Fluid Flow Machinery